ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE,

BOMBAY PRESIDENCY,

FOR THE YEAR

1910-1911.

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No. A.—7697 of 1911.

From

G. F. KEATINGE, Esq., I. C. S.,
Director of Agriculture, Bombay,
Poona;

To

The CHIEF SECRETARY to GOVERNMENT,
Revenue Department, Bombay.

Poona, 27th October 1911.

Sir,

I have the honour to submit herewith the Annual Report of the Agricultural Department for the year 1910-11 in the form prescribed in Government Resolution No. 4878 of 20th May 1911.

CHAPTER I.

Administration.

2. I remained in charge of the office of the Director of Agriculture throughout the year. The other posts held by Gazetted Officers were held as follows:—

Not connected with the Agricultural College.	Connected with the Agricultural College.
1. Mr. T. F. Main, Deputy Director of Agriculture, Bombay Presidency.	1. Dr. H. H. Mann, Principal, Agricultural College and Agricultural Chemist.
2. „ G. S. Henderson, Deputy Director of Agriculture in Sind.	2. Mr. J. B. Knight, Professor of Agriculture.
3. „ A. A. Musto, Agricultural Engineer.	3. „ W. Burns, Economic Botanist.
4. „ B. M. Desai, Divisional Inspector of Agriculture, Northern Division.	4. Rao Saheb G. K. Kelkar, Assistant Professor of Agriculture.
5. „ P. C. Patil, Divisional Inspector of Agriculture, Central Division.	5. Mr. H. M. Chibber, Assistant Professor of Botany.
6. „ M. L. Kulkarni, Divisional Inspector of Agriculture, Southern Division.	6. „ S. L. Ajrekar, Assistant Professor of Mycology.
7. „ V. H. Gonehalli, Divisional Inspector of Agriculture for Konkan.	7. „ H. K. Metha (upto May 1911), and S. B. Butani (from 15th May), Assistant Professor of Physics and Mathematics.

Except for periods of privilege leave all these officers remained in charge of their posts during the year.

3. In addition to the officers abovementioned as forming part of the ordinary staff of this Department, Mr. E. Holmes-Smith, Supernumerary Botanist, has been temporarily posted to this Presidency, and has been engaged on a preliminary survey of the rices grown in this Presidency, and Mr. G. D. Mehta has been serving in a temporary appointment and has been engaged in investigating the seed supply of the Broach and Ahmednagar Districts. Mr. Holmes-Smith has made a collection of the rices of the Presidency, has grown them, roughly classified them and has recorded a great amount of valuable information about them. He has now left India and has handed over his work to Mr. Burns. It has not yet reached a stage at which his results can be published, but it forms a valuable preliminary investigation which will be the

basis for further work. Mr. G. D. Mehta's work also makes a valuable addition to our knowledge on the subject; indeed, it is practically the only precise and systematically collected information which we have on the point. Mr. Mehta has been given a probationary post in the Imperial Agricultural Service, and will, I understand, be transferred shortly to Pusa.

4. The departmental organisation divides itself naturally into two parts, the central organisation in Poona, and the district organisation. As will be seen from paragraph 2, half of our superior staff are stationed at Poona. At first sight this may appear to be somewhat disproportionate; but the necessities of the College make it inevitable. Apart from this, however, it is really an advantage to have a strong staff stationed at one spot. The Agricultural College with its laboratories, library and farm devoted to instructional purposes, the Poona Dairy, the Ganeshkhind Botanical Gardens and the Mánjri Farm, together with their staffs, combine to make Poona an effective head-quarters for the Department. This is an important matter, and I am satisfied with the progress that has been made in this direction. The College staff, of course, do not confine their activities to Poona; but have work on hand in many parts of the Presidency. This is eminently desirable both from the point of view of the departmental work and in the interests of the staff itself, for by so doing they enlarge their experience and gather knowledge on many subjects with regard to which we are still sadly lacking in information. It must be recognised, however, that the extensive outside work which the members of the College staff have to do as members of the Agricultural Department takes up a lot of their time, and they cannot be regarded as full time educational officers. This matter was commented on by the Committee deputed to report on the various Colleges, who considered that the college staff was insufficient to tackle the work which they had undertaken. I think that there can be no question that this view is correct. The matter has been represented to Government; but it has not been possible to obtain the additional staff which we require.

5. In the districts the departmental work has expanded. The Alibág farm was opened during the year under report, and the Gokák and Sukkur farms which had been started a short time previously have been considerably developed. Proposals to open a new farm at Lárkána during the current year were sanctioned and money was provided in the budget; but owing to the financial situation due to defective rains it is doubtful whether funds will be at present available. The work of the Divisional Inspectors has considerably expanded, and each of the Divisional Inspectors, Northern Division, Central Division, Southern Division, and Konkan as also the Inspector of Experiments in Sind has working under him a staff of fieldmen which has enabled them to extend their operations. In the Konkan we have had to go more slowly, owing to our lack of experience; but I hope that some additional staff will soon be made available there. We have now serving in the Department 50 men who are graduates of the Agricultural College or are graded with them. These men obtain good pay and have good prospects. They are for the most part stationed on the farms. I am bound to say that I am somewhat disappointed with their performance. On the farms they have definite routine work set to them in connection with the various experiments. These experiments are designed and supervised by the Deputy Director; and the results obtained from them are interpreted by him. In this connection the fieldmen merely work in a subordinate capacity. This work, of course, has to be done, but I find that most of them are content with a mere routine performance, and show little desire to make and record any independent observations or to develop any original line. This is, no doubt, due in part to the fact that the Deputy Director with his unwieldy charge, comprising Gujarát, Khándesh, the Konkan and the Southern Marátha Country has little time to devote to the personal training of staff. In former days when there was comparatively little work being done in the Department, Mr. Mollison, the then Deputy Director, was able to undertake the personal training of his men, and the results which he obtained were striking. At present Dr. Mann and Mr. Burns, who each have a small staff working under their immediate eye, are able to obtain somewhat similar results. Mr. Main is overwhelmed with a mass of departmental work and with travelling

over the length of the Presidency proper. It is very difficult for him to supervise the experiments on his eight scattered farms, much less is he able to devote the necessary attention to the personal training of the men. Yet these men must be properly trained and guided in the early stages if they are to develop on the right lines. The success of the Department must in the long run mainly depend on the quality of the work that we can get out of them. I have already reported to Government that it is essential to progress that Mr. Main's charge shall be subdivided. Apart from the extensive area, the varied characteristics of the different tracts composing it and its geographical distribution make it an impossible charge for one man. The considerations noted above add a further argument, indeed the strongest of all; for I regard the training of the staff as the most important matter that we now have on hand. When we get some additional supervising staff we may expect improvement, and hope that our graduate fieldmen will take up work of a kind for which their training and position should fit them, and for which they certainly have time and opportunity. Meantime I have done my best to indicate to the staff both orally and in writing some directions in which they may undertake enquiries, and to make it clear to them that graduates who fail to develop any capacity for independent observation or for the practical adaptation of their knowledge, will probably not be worth retaining in the Department, and certainly not worth promoting to the higher posts. In saying the above I do not wish to blame the staff in general or any one in particular, but merely to indicate our most serious problem. I believe that there is plenty of good material in our junior staff if we can manage to develop it properly.

CHAPTER II.

Agricultural Education.

6. The detailed reports submitted by Dr. Mann and printed as Appendices A and B to this report leave me little to say on this subject. The main College buildings are now completed, and all that remains now is to complete the hostel for the students. This work is proceeding very slowly, but presumably will be completed within a year or two. This is the fourth year that the College has been accommodated in half-finished buildings, and the inconvenience and discomfort of conducting educational work under such conditions have been a great handicap to the College staff. I am, however, well satisfied with the progress made in increasing the efficiency of the institution.

7. The students have, on the whole, been very successful in obtaining employment, and it is satisfactory to note that some of them are taking up farming as a profession. It is greatly to be desired that we should attract more of the sons of large landowners who are intimately connected with the management of their lands. Such students would after the completion of their course have adequate land to operate upon and the means requisite for its development. The sons of professional men of means who can purchase a property and equip it adequately often provide promising material for progressive farming. The boys of the true cultivating class whom we manage to attract by our scholarships add a useful element to the College and give it more of a true agricultural atmosphere than would be possible in their absence; but it must be recognised that they seldom have sufficient land or capital to make them willing to take up independent farming, and are usually compelled by their circumstances to look out for Government service of some kind the moment that they have taken their degree.

8. There is a considerable demand both on the part of Native States and on the part of large landowners for trained agriculturists. The demand is naturally only for trained agriculturists *with experience*, and we have in the past been able to supply this only by lending men who have already served some years in the Agricultural Department. We have done this in a considerable number of cases; but the men who have obtained Government service are never willing to go elsewhere unless they retain their lien on their Government appointment. We can hardly extend this practice much further; for, besides the inconvenience to the Department of giving up the men that it has trained, the eventual return of these men to the Department at any time that may suit

them or their temporary employers, will be liable to cause inconvenience. In the interests of the public which requires experienced agriculturists and of the students who require employment, however, we must try to adapt ourselves to the circumstances. Dr. Mann is devising a scheme for giving a post-graduate training in practical estate development and management. Such a training will not be easy to organise, but it will be possible, I believe, and will be more effective for the purpose indicated than service on an experimental farm. There is some chance that the accomplishment of this scheme will be facilitated in the near future with the help of a private benefaction. The matter is one of considerable importance.

9. I agree with the remarks of Dr. Mann (Appendix B) regarding the vernaculur agricultural school at Poona. We have attracted the right class of boy and are giving them sound instruction. When we are turning out a number of boys so trained every year it will inevitably have an effect on the agriculture of the Presidency. I shall be very glad when it is possible to move the school to the site selected at Loni. This move is only waiting for the construction of the necessary buildings for which provision has been made, and the construction of the buildings is hung up for want of the detailed plans and estimates. I hope, however, that it will be possible to move the school there in June next.

10. In connection with vernacular Agricultural schools the first complete stage at which the Department is aiming is the provision of one school each for the Deccan, Southern Marátha Country, Sind, and Gujarát. The school in the Deccan is an accomplished fact, and only awaits location in its proper place. The School in Sind has been sanctioned and provision of funds has been made in the current year. It will shortly materialise, unless the financial situation renders it necessary to withdraw the allotted funds. In the Southern Marátha Country, the Lingáyet Education Fund have offered a good building in a suitable locality for use as an Agricultural school, and a Lingáyat gentleman has offered land for purposes of the school farm. An Agricultural graduate is in tráining for the post of head-master of this proposed school, and I hope that the school will come into existence in 1913. The matter has already been reported to Government. The school for Gujarát is still in the future. The successful establishment of an Agricultural school in a prosperous tract and amongst very high class cultivators would present some difficulties; and it is probable that the best thing will be to add an Agricultural school to the Muvalia Farm near Dohad. This farm has been established mainly to introduce better class cultivation amongst the Bhils of that locality, and the addition of an agricultural school will be a good means of furthering that end. The standard of education demanded from the boys taken into such a school would have to be very low, far lower than in the case of the Deccan and Southern Marátha Country schools; but this is not necessarily an objection. In establishing such schools we should avoid any attempt to keep to one fixed pattern, and should try to adapt each school to the particular requirements of the locality in which it is established.

11. A new departure was made during the year under report of advertising definite short courses in specific subjects at fixed times for adult cultivators on our farms. A course in sugarcane culture and gul making was advertised at Mánjri, in Cattle management and dairying at the Poona Dairy and in ploughing and seed selection at Surat and Dhárwár. The course at Mánjri lasted for 5 weeks and was attended by 21 men and that at the Dairy farm lasted for 3 weeks and was attended by 4 men, while those at Surat and Dhárwár attracted few people. There is a fair opening for such short courses in a few special subjects. The people attending them are likely to be the land-owning rather than the mere cultivating classes. The true cultivator seldom cares to spend more than a day or two on a Government farm. These courses will be continued as suitable opportunity offers.

12. Mr. Burns continues to take a limited number of young men as pupil fieldmen in horticulture at the Ganeshkhind Botanical Garden, and in a few cases other men have been given instruction on our farms. For the present, however, the best way to get at the cultivators is by demonstrations, shows, and lectures. These matters will be dealt with in another chapter.

CHAPTER III.

Research and Experiment.

13. I find it difficult to know what I can usefully write under this heading. The farm reports contain an account of the scientific work, and the appendices contain a popular account of the results obtained. It would be of little interest if I were to attempt to review our experimental methods or to claim that such and such facts had been discovered during the year. When we have information to impart we publish it in a special bulletin or leaflet; and a bare statement of isolated facts, apart from the circumstances under which they were observed, is apt to be misleading. I therefore propose to confine myself to a few general remarks about agriculture, dealing with the most prominent features and needs of this Presidency.

14. It would be out of place here to deal with the general conditions under which agriculture is conducted, and to dilate on such matters as the nature of the land tenure, the dearth of capital or the waste of labour. It must be recognised, however, that such conditions are fundamental and must very largely govern our progress. In the Deccan, for instance, the number of holdings which can be called economic, that is to say, the characteristics of which admit of profitable agriculture, is relatively small; whilst over the greater part of Sind the nature and circumstances of the land tenure must offer a serious obstacle to progress. These are matters which can be improved if the facts are recognised. Meantime we must keep an eye on them.

15. To turn to matters more closely connected with the technique of the farmer, our all important problem is to determine the best and most economical way of reducing a weedy, hard stubble to a clean, well-tilled seed bed, and to put the cultivators in the way of performing this operation. At present the majority of them make little attempt to do so. I have in former reports insisted on the fact that in many tracts half of our best lands are so infested with deep-rooted weeds that they are totally unfit to grow crops. At the present moment (October 17th) when the kharif crops round Poona are in such a poor way, we are obtaining on the better lands of the College farm excellent crops of bájri and jowári which will give a fair return in grain and a handsome profit as fodder. While cotton tracts reporting 17 inches of rain are complaining that the cotton is ruined or severely damaged by drought, the cotton on the College farm is in good condition. The soil varies from medium black, such as is found all over the Deccan, down to the poorest murrum. The rainfall has been short and ill-distributed, amounting to only 11 inches of rain, which was practically confined to the months of June and August; but the land is "in good heart," that is to say it is properly tilled, free from weeds, and gets a light dressing of manure every other year. The seed is sown without any waste of time, the roots get a chance of penetrating the soil, and the soil is reduced to a condition which enables it to retain the moisture. In a year like the present this means all the difference between crops and no crops. For the poor light soils, of course, plentiful and well distributed rain is essential. It is seldom obtained, however; and the man who expects to make his living out of such lands in the Deccan is playing at hazard with the odds all against him. On the better lands, however, there is a great opportunity for improvement. The question is one of implements and draught cattle.

16. As regards implements we have introduced ploughs of various patterns and are selling a larger number each year. A few years ago Rs. 40 was thought to be a lot of money to put down for a C. T. 2 plough; but during the last year there have been many demands for a plough of larger size costing Rs. 60. In some tracts iron ploughs are becoming very popular, and it is encouraging to hear from the Collector of Sholápur that in one village in his District the people have bought 80 iron ploughs, that they talk most enthusiastically about their work and are thinking of buying more. In parts of the Belgaum District, also, iron ploughs are being freely purchased, and all Districts in the Deccan and Karnátak are taking some. We have now got a good deal of knowledge regarding the implements best suited to different conditions; and I hope that we shall soon be in a position to publish information

on the subject. Apart from black soils I am sure that much waste of power occurs in the cultivation of rice lands due to defective implements. We are introducing various patterns of light iron ploughs for such lands, and there is still much investigation to be done in this connection. The plough is, of course, the most important implement, but the possibilities of improved harrows, cultivators and clod-crushers are also receiving attention.

17. As regards draught cattle the idea of starting a bull breeding farm at Sholápur had been considered in the previous year. The idea was approved of by Government and its realisation was postponed only till funds were available. I determined, however, not to follow up this idea for the present, since, in connection with the deficiency of cattle, the question of fodder seems to me in our present circumstances to be far more important than the question of good breeding bulls. I see constantly reported in the weekly season reports of various tálukas that "agricultural cattle are deficient" and the natural inference would be that this is a purely local and temporary phenomenon. I do not know on what the officers who make such reports base their statements. They are undoubtedly right; but the deficiency is permanent and general. Even in the good period which ended about 1895 the work cattle in the Deccan were inadequate for the work which they had to do, and at the present time they are probably about 30 per cent. short of the requisite number. The number is strictly limited by the amount of fodder available. Something may undoubtedly be done to improve matters by showing the people how to use to better advantage the fodder that already exists. In several parts of the Presidency, notably in upper Gujarát and the Southern Marátha Country, considerable areas of good grass land exist. Some portion of this is cut for sale in towns, usually after it has seeded and lost a great part of its value; but most of it is indiscriminately grazed, and, inevitably, much of it is trampled under foot and wasted in the process. Inferior grasses which would be of value if cut green and made into hay or silage are left standing till they have practically no feeding value; and by the hot weather the fodder supply is habitually reduced to a minimum, and sometimes below that point. As a first attempt to tackle the problem I have selected several hundred acres of waste land growing fair grass at Tegur in the Dhárwár Táluka, which the Collector has assigned to this Department. The object of the experiment will be to show that it is profitable to cut this grass with a mowing machine before it seeds and to store hay and silage to feed to the young stock in the hot weather. The tract is a good breeding tract, but the stock bred there are not good. Having got a reserve of fodder I propose to add a good breeding bull, and hope to show that, with fodder reserves and a good bull, it will be possible to breed bullocks worth Rs. 150 a piece, instead of the present bullocks worth only about Rs. 50. At first I think that it will be preferable that we should not encumber ourselves with a herd of our own and all the paraphernalia of a breeding farm. We will experiment on the local cows and calves in a way that the people cannot fail to appreciate, since the giving will be all on our side. Incidentally we will experiment with hedges and grass improvement. The undertaking is on a small and cheap scale, but I think that it is on the right lines.

18. Apart from the provision of fodder for the hot weather arises the question of a more permanent reserve of fodder against years of famine. Government are aware of the serious losses of cattle which occur in the years of famine, amounting in extreme cases to over half the stock in some localities. So long as we are subject at intervals to a knock down blow of this nature nothing like steady agricultural progress can be possible. The question was touched on in Government Resolution No. 6468 of 27th June 1908, and has not been lost sight of. I am glad to say that at the present moment when lack of fodder is being so keenly felt in many parts of the Presidency we have on most of our farms a good reserve which will enable us not only to feed our own beasts but to offer hospitality to several hundred valuable animals at Chharodi, in the neighbourhood, where the pinch is being most severely felt.

19. I subjoin a statement showing the fluctuations in the value of the Sundhia kadbi which we stalked at Nadiád in December 1909, from which it will be seen that the operation has been a profitable one to us; since the normal

seasonal variation in price amounts to 85 per cent. and the scarcity variation to 600 per cent.

Rates of jowári fodder at Nadiád.

Months.	Per 100 bundles = 300 lbs.		
	1909.	1910.	1911.
	Rs. a. p.	Rs. a. p.	Rs. a. p.
January	.....	2 7 0	3 2 0
February	.....	3 0 0	3 8 0
March	.....	3 10 0	3 12 0
April	.....	4 0 0	4 8 0
May	.....	4 8 0	5 0 0
June	.....	4 8 0	6 0 0
July	.....	No demand.	.....
August	.....	Do.	12 0 0
September	.....	Do.	18 0 0
October	.....	Do.	.....
November	.....	Do.	.....
December	2 11 0	3 0 0	.....

The obvious inference is that cultivators should store fodder for themselves. In some parts they do so to a limited extent; but in many localities incendiarism is very common, and a man who puts up a fodder stock is regarded as displaying the height of imprudence, since by so doing he delivers himself bound into the hands of his enemies and offers himself as a victim to the blackmailer. He is in fact substituting a greater risk for a lesser one. I am afraid that we cannot in the near future look for much relief from any extensive adoption by the people themselves of the habit of storing fodder. There is, however, an alternative. In a famine year Government regard it their duty to make great efforts to cut and bale grass in jungle tracts and to despatch it to affected localities. This affords much relief so far as it goes, but it has some obvious disadvantages, as follows :—

(1) In a year of extensive famine the grass in many jungle tracts may be in defect.

(2) The work has to be organised and pushed on in a hurry, and in any case the grass cannot be ready before about the end of October.

(3) The grass is often of poor quality, and is rejected by cattle accustomed to feed only on kadbi.

(4) The jungles are frequently somewhat inaccessible, which greatly enhances the cost of getting out the grass; and, in the case of districts situated at a distance from the jungles, the cost of transport makes the price of the grass prohibitive.

20. As an alternative or a supplement to these operations I think that a scheme might be devised by which fodder could be systematically stored in good years at a number of suitable centres to provide against bad years. The centres would be fixed at places accessible to the railway and at which fodder is plentiful and cheap in good years. The fodder chosen would be the fodder to which the cattle of the locality were accustomed, grass, kadbi or some other fodder as the case might be. If cut and collected systematically, on a large scale and by the most effective methods its cost could be reduced. In some cases it is likely that baling with a power press would be indicated, and possibly there would be an opening for chaffing, shreding and making up effective feeding mixtures for compression. In this way fodder reserves might be located in the tracts most in need of them, and the fodder stored would be suitable to the needs of each tract, available at any time, and, if compressed, would last well and be fairly impervious to fire and to weather. When the fodder crop of any year was fairly safe and the chances of famine remote part

of the reserve might be disposed of (say) in August or September, and replenished later on from the new crop. By doing this and taking advantage of the violent seasonal fluctuations and the high prices that are current in large cities and in localities where fodder is usually very deficient a good steady income could be obtained in an ordinary year; and in a famine year the real advantage of the scheme would be realised. Indeed when once the desired reserve was stored the supply of any year could be devoted to meet the normal current demand. Looking at the matter from another point of view and assuming that 5,000 lbs. of fodder would be sufficient to keep a grown animal alive in a famine year, together with what little grazing could be picked up, I believe that in most tracts this amount of fodder could be stored in a good year at a cost of Rs. 25, and in many localities for less. To ensure an animal against famine, therefore, it would be necessary to lock up a capital of only Rs. 25, that is to say, calculating the rate of interest at 4 per cent. the cost of insurance would be only Re. 1 a year for each full-grown animal. Having regard to the sacrifices already made by Government (grass operations, tagái, etc.) and by the public (pinjerápoles, etc.) to preserve cattle, and the inadequate results that are obtained, I cannot help thinking that a more effective scheme could be devised in which many cultivators might join by paying something in the nature of insurance premia. I am collecting information on the subject and hope to be in a position to make proposals to Government before long.

21. Admitting, however, that much can be done by proper organisation to improve in numbers and in quality and to safeguard against starvation the draught cattle, there is always likely to be a marked tendency for the supply of such animals to be inadequate. In connection with this difficulty the question of steam plough has excited a good deal of interest during the past year. In forwarding to Government a representation on the subject I made out an estimate of the cost and profit of working a large double engine steam ploughing plant (*vide* Government Resolution, Revenue Department, No. 255 of 10th January 1911), and I have subsequently issued a printed note on the subject. The initial cost involved and the reluctance of any individual to embark on a new and speculative enterprise present obstacles to the inception of such an undertaking; but I consider that there are many tracts, especially in the east Deccan and Southern Marátha Country, which are eminently suited to steam ploughing, and I think that with reasonably efficient mechanical and business management a steam plough could be made to pay well. The effect on the crops would be striking. Over large areas the outturn of cotton could be doubled in this way, and the effect would last for years. Apart from some system of mechanical traction I see no prospect of the large areas of rich lands now infested with deep-rooted weeds being brought into a condition fit for effective cultivation during the life-time of the present generation.

22. Not having the funds to purchase a steam plough, and being very doubtful of the suitability of a cheaper motor plough to our conditions, I tried the experiment of importing a large, French geared plough for deep cultivation. Its cost amounted to Rs. 3,000. The gearing is a simple mechanical device which increases twentyfold the effectiveness of the bullock power applied. It has worked very successfully and is much appreciated by the cultivators in Dhárwár who are willing to pay Rs. 100 a month for its use. Mr. Main has referred to it in Appendix C, and an illustrated note on the subject will shortly appear in the "Agricultural Journal of India."

23. All the above remarks on the subject of implements, cattle and traction arise in connection with the fundamental difficulties of cultivation. I regret to state that our experiments in "dry farming" have not progressed very far. The principle involved in "dry farming" is to give the land special and exceptionally good cultivation. So long, however, as the great bulk of the cultivators are not in a position to give their lands ordinary, fair cultivation the advantage to be derived from exceptionally good cultivation must remain a matter of somewhat academic interest.

24. I now propose to deal briefly with the questions of seed and manure. It will be realised that the importance of good seed and manure becomes marked only in the case of clean and adequately tilled lands.

As regards the seed used by the cultivators Mr. G. D. Mehta's enquiries in the Broach and Ahmednagar Districts show that the cultivator suffers a good deal of loss in this matter. He may pay interest at the rate of 60 or 100 per cent. on the advance of seed between seed time and harvest; and he frequently has to reject as unfit for seed purposes as much as a quarter or even half the grain that he may purchase. Even then a large part of the seed which he actually sows is useless for seed purposes. In the case of cereals the percentage of useful seed on seed sown is 83·5 as against the European standard of 95, and in the case of leguminous seeds the percentage works out to nearly 80. In the case of cotton the percentage is between 60 and 70. The defective seed is due in the case of cereals mainly to weevils, in the cases of pulses to hard seeds, and in the case of cotton to damage to the seed in the process of ginning. In many cases the quality of the seed used is very poor. The information collected points strongly to the necessity for some agency which will undertake the seedsman's business. The above remarks deal with ordinary seed. A few remarks are now necessary regarding exotics and the pedigree seed which we produce on our farms.

25. The work done in connection with cotton improvement is now entering on a new stage. Mr. Main has given a good account of it in Appendix C to this report, and a printed note on the subject was issued from this office in January last, copies of which were supplied to Government, to the Press and to the public bodies interested in cotton. The most noteworthy facts are:—

(1) That the area indicated for exotic cottons has been narrowed down to Sind, which is eminently suitable for American and Egyptian cottons, and to the South-East of the Dhárwár District where Cambodia gives very good results.

(2) That out of the many hybrids and pure line bred cottons tried on the Surat Farm two have been selected as the best. These cottons give a distinct advantage both in quantity and in quality over the ordinary local cotton, a fact which is appreciated both by the cultivators and by the Cotton Trade. During the current year an area of over 10,000 acres in the neighbourhood of Surat has been sown with farm seed, and a Bombay syndicate will buy up 2,000 bales of the produce at a figure 5 per cent. in excess of the current, local rates.

(3) Khándesh is evidently pre-eminently suited for producing an early maturing cotton with a short, bright staple. The demand for such cotton is great, and prices are tending more than ever in favour of short-stapled, prolific cottons. The figures given in Appendix C show the great advantage that may be gained by sowing the more prolific seed, and incidentally demonstrate the large profits that can be made from cotton-growing in a good year. There can be little doubt that in Khándesh our policy must be to multiply and distribute pure Roseum seed. Unfortunately the present bad season at Dhulia will seriously check this work.

(4) The relative advantage in price of Broach seed cotton grown in the Southern Marátha Country over the local Kumpta cotton has again been maintained; indeed it was higher last year than before, and appears to lie not only in the better ginning percentage but also in the quality of the lint. The good prices obtained for Broach cotton at the auction held in Dhárwár last May have stimulated its cultivation there, and it is estimated that the area sown with the cotton in the Southern Marátha Country has during the current season gone up to 5,000 acres. Selected Kumpta seed continues to show its superiority over bazar seed.

26. In the case of such crops as jowári it is more difficult to obtain marked results from seed selection. Varietal trials almost invariably show that the varieties grown in any locality are those best suited to that locality, and they produce, of course, the kind of grain which the people of the tract are accustomed to eat. The outturn of such crops is determined so largely by the various factors connected with the treatment of the soil that the advantage of selected seed tends to be obscured. There can be little doubt, however, that the careful pure line breeding and rigid selection that is being carried out on the various farms will in the long run produce a marked result.

27. The rapid success of foreign groundnuts, especially in the Deccan, has before been reported. The work of seed distribution still continues; but in many tracts they are now so well established that we shall be able to relax our efforts in this direction. The following table shows the advance that has been made in groundnut cultivation in the Deccan during the ten years that we have had the matter in hand:—

Year.	Area cultivated with groundnuts in the Deccan.	Net export of groundnuts from the Deccan.
	Acres.	Maunds.
1902-03	56,000	110,000
1903-04	72,000	115,000
1904-05	74,000	164,000
1905-06	76,000	211,000
1906-07	92,000	300,000
1907-08	112,000	175,000
1908-09	110,000	316,000
1909-10	127,000	893,000

Apart from the profits obtainable from the groundnut crop its after-effects on the soil are most marked and beneficial, and improve the succeeding crops for several years to come.

28. As regards manures night-soil and poudrette continue to give very good results; mhowra refuse is a useful manure where it can be obtained; artificials can be made to pay with cotton in a good year and at the present high prices, but for dry crops farmyard manure still remains the cheapest fertiliser. For sugarcane nitrogenous top dressings of sulphate of ammonia and oil-cakes yield large net profits. This has been proved to the people in several localities, and a considerable demand for them is setting in. Potash continues to give promise for sugarcane, and artificials have probably got a future for such crops as chillis, lucerne and tobacco. I hope that a systematic series of experiments will soon be started to determine the exact value of artificials for the more valuable garden crops. In irrigated tracts the demand for oil-cake is now large and a demand for artificials is commencing. Agencies for the supply of these manures are badly required. The practice of green manuring with sunn hemp has been studied during the past year. There is no doubt that it is a most profitable practice and capable of extension in many tracts and for many crops. This potential source of manure must be drawn upon when the new canals set up an increased demand for fertilisers.

29. In the matter of Chemistry Dr. Mann's report (Appendix G) speaks for itself. His most important and exacting work is probably in connection with salt lands. His analyses of manurial and feeding materials are suggestive.

30. In the Botanical line systematic work has been started on important matters such as fodder plants, green manures and hedge plants, from which I anticipate much profit. The study of fruit culture, undertaken by Mr. Burns and his staff, and in particular of mango growing which is such an important adjunct to agriculture in many parts, cannot fail to give useful results.

31. The efforts to suppress the rice-hopper pest at Belgaum have met with considerable success. During the year under report enormous quantities of hoppers were caught and the pest was greatly minimised. These efforts have been continued during the current year, and it is claimed that this pest of long standing has now been practically eradicated. It was fortunately confined to a comparatively small area and could therefore be met by a systematic campaign organised and managed by the field entomologist. In the case of the bájri hopper, which was so widespread over the Deccan and Southern Marátha Country, no such organised campaign was possible. The experimental efforts which we made to meet the case have been reported. It was ascertained that by bagging the hoppers the damage could be minimised; but that under most circumstances

it was hardly a business proposition in cases where labour had to be hired; and that for any thing like real success a degree of cooperation which could hardly be looked for amongst the cultivators was necessary. During the present year this pest seems to have decreased considerably.

32. As regards Mycology the treatment of jowári seed against smut continues to make headway amongst the cultivators. Mr. Burns' experiments in spraying against vine mildew indicate success. Mr. G. S. Kulkarni made a careful investigation into the circumstances and distribution through the Presidency of red rot in sugarcane, and did useful work in demonstrating the efficacy of using disease free sets. The investigations made by Dr. Coleman of Mysore into the Koleroga disease of betel-nuts are likely to be of use to us, since this disease is prevalent in Kánara; and I hope that we shall be able to take up remedial measures this year.

33. In dealing with such matters as the supply of implements, seed and manure, the working of a steam plough or the effective storage of fodder it has been noted in several places that an agency of some kind is needed to perform the necessary operations and that the efforts of this Department must be to a great extent checkmated if no such agency is forthcoming. There is no doubt that the public look to Government to undertake such matters, as was made clear at the Agricultural Conference held in Poona in 1909. Our Agricultural stations do to a great extent perform the functions of a dealer in implements, seed and manure; but it is impossible that we can do the business required for the whole country side. On the other hand Government is apt to look to individuals or to the cooperative movement to undertake such enterprizes. Sometimes individuals can be found to take up such work, and I hope that we shall soon be able to obtain private agents to retail implements and concentrated manures. Much may be expected in the future from the cooperative movement; but there are some important lines of development which are likely to hang fire sadly unless some effective agency can be evolved for the purpose. Personally I am of opinion that at the present stage in our progress the only effective agency that it will be possible to find to carry out some of the most important developments is something in the nature of a state-subsidized company, and I believe that it would be a great step in advance if the principle involved were accepted.

CHAPTER IV.

Demonstration, Aid to the Public, Agricultural Shows, Agricultural Associations and General Progress.

34. During the year under report 29 shows and demonstrations were held in the various parts of the Presidency. The Belgaum show was the most ambitious effort, but shows of some magnitude were held at Sholápur, Háveri and Amalner. The demonstrations were for the most part held either at the Agricultural Stations or in connection with some fair or local gathering. Apart from those pre-arranged shows, the Divisional Inspectors and their staff give many smaller demonstrations and lectures in the course of their tours. I am well satisfied with the progress of this work, about the utility of which there can be no doubt; but I have nothing to add to the remarks that I made last year.

One new departure was made in this connection. Parties of good garden cultivators were taken from the Deccan, Southern Marátha Country and the Konkan to see the admirable and intensive garden cultivation which is practised in the neighbourhood of Surat and Amalsád. They were lodged on the Surat Farm, accompanied by the Divisional Inspector of their own Division, and shown over selected gardens by the Divisional Inspector, Northern Division. The cultivators who came certainly enjoyed the trip and learnt something. I was well satisfied with the result of the experiment and propose to repeat it when suitable occasion occurs.

35. The work of the Divisional Inspectors has considerably expanded and their staff has been enlarged to cope with it. They are now freely consulted both by cultivators and by landlords who wish to develop their lands. An extensive distribution of seed, and particularly of cotton seed, took up much time. The work of demonstrating such matters as implements, seed steeping, effective Gul-making, and sugarcane manuring was pushed on; and experiments were laid out for Associations and progressive individuals who wished for them. The Divisional Inspector, Central Division, made a very useful preliminary Agricultural survey of part of the Násik District and has recorded some interesting observations. I think that we must aim at systematic agricultural surveys of typical tracts, which are capable of yielding valuable results when made by a skilled observer who has the true instincts of a cultivator.

36. During the year the following new Agricultural Associations came into existence :—

(1) The Jámner Agricultural Association, Jámner (East Khándesh),

(2) The Junnar Agricultural Association, Poona District,

(3) The New Agricultural Association, Gokák, Belgaum District,

(4) The Táluka Agricultural Association, Hungund (Bijápur District),

(5) The Sirsi Táluka Agricultural Association (Kánara District),

(6) The Agricultural Association, Bhátkal (Southern Division, Kánara),

which with the previously existing ones makes up a total of 38. I observe that in the Madras Presidency it appears to be held that Agricultural Associations have proved a failure.

37. I subjoin the following remarks on the subject which I recently communicated to the Inspector-General of Agriculture who asked my views on the Associations which had been formed in this Presidency :—

"The Associations are not connected with Cooperative Credit Societies. Most of them owe their origin to the efforts of some individual who takes an interest in agriculture and is anxious to be helpful in the matter of agricultural improvement; and the tendency is for the work of each Association to represent the activities and energy of the individual who has organised it rather than the collective energy of the Association as a whole.

"The agricultural department supplies to these associations the publications which it issues, and members of the Department visit them as often as is practicable. In this way they serve as a link between the department and the cultivators and tend to stimulate and keep alive interest in agricultural progress. Some associations have, with the help of the department, undertaken experiments with fair success, others have acted as agents for the supply of implements such as iron ploughs, which is a very useful work, many have organised shows, which have certainly produced some results and have involved much labour and some expense to the organisers. It is not possible to point to very striking results, but on the whole I am satisfied with the progress made in this direction, and think that with continued attention and fostering care some of the associations will develop into useful bodies. Two difficulties are prominent—

(1) The difficulty of sustaining the interest and continuity of work.

(2) The difficulty of providing funds.

"To overcome the first difficulty I think that each association ought to have a paid man to act as organiser and secretary. He need not be a highly paid man, but should be a cultivator and able to read and write the vernacular. It should be his business to keep in constant touch with the Department and to organise profitable lines of development for his association. The second difficulty can, I think, be overcome in the long run by grafting Cooperative Credit Societies on to Agricultural Associations. I notice that in France the terms Agricultural Association and Cooperative Credit Association appear to be alternatives for the same thing, and that every Agricultural Association is a Cooperative Credit Society and *vice versâ*. I should like to see the same thing take place in this country. I know of no other way in which the financial difficulty can be satisfactorily overcome, and without funds no association can do much. A word must be about the Deccan Agricultural Association which acts as a Central Association. It has collected fair funds and has some Rs. 7,000 invested, and obtains a good many annual subscriptions. Part of its funds are invested in Cooperative Credit Societies. It holds quarterly meetings at which papers on agricultural matters of interest are read and discussed. It runs a vernacular Agricultural Journal which has obtained a circulation of about 3,000. It has appointed a number of sub-committees to consider special subjects and is endeavouring to affiliate other

associations with it. From the nature of its position as a central association it cannot well interest itself with the details of cultivation in any particular place, but it has been instrumental in undertaking some seed distribution, and some of its members have taken a keen interest in assisting in the movements of Agricultural progress, and Cooperative Credit. I think that there is a good field for the work of such Central Associations—

(1) in stimulating the smaller associations into activity, in connection with which a paid organiser is required, or in the alternative the Central Association might help the smaller associations with funds to pay for organisers of their own ;

(2) in acting as agents for the supply of implements, manure and seed ;

(3) in organising, and, if necessary, promoting companies for the development of large schemes such as steam ploughing or providing an adequate reserve of fodder for tracts subject to famine.

"Here again the question of funds arises. The association must have an income from its invested funds and annual subscriptions sufficient to pay for its general organisation ; and for undertaking definite large schemes involving the outlay of considerable capital it must raise the funds by promoting joint stock companies or Co-operative Credit Associations, either amongst its own members or amongst the public, for specific purposes."

CHAPTER V.

Agricultural Engineering.

38. In Appendix H, Mr. Musto gives an interesting account of his year's work and records his views on the future that there is for machinery in connection with agricultural operations in this Presidency. There is certainly a fair opening for raising water by mechanical means though the scope of such operations is not very extended owing to the limited supply of water suitable for lifting which exists in most localities during the hot weather. On the Mutha Mulla river, for instance, in which the flow of water is maintained throughout the hot weather by the seepage from the canal and the irrigated fields a number of engines and pumps have been erected which are about sufficient to exhaust the hot weather flow : and if more engines are erected there they will probably run short of water in the hot weather. There are, however, a good many rivers in the Presidency which offer good facilities for a limited amount of pumping. The main obstacle to the more extended use of machinery is the difficulty of obtaining even moderately skilful and careful drivers for the engines. Good results are usually obtained only when he owner carefully supervises the work himself. An admirable piece of work was done in the past year at Ránjangaum Sándas (Poona District) by the Kokje family who have erected a large pumping plant on the banks of the Bhima river, and have engaged on extensive operations to level and embank their land so as to make it suitable for irrigation. Their enterprise has been conducted with energy and determination and deserves every success.

39. The well boring operations in Gujarát show a further marked improvement over the substantial results of the year before. This is due to the fact that we have found in the Borsad Táluka region where a good supply of sub-artesian water can be tapped with fair certainty at a depth of about 100 feet below ground level. The men are getting more expert at the work and can now go down without difficulty to greater depths than 100 feet below ground level, if necessary. Eight boring plants were at work throughout the year and a supply of water sufficient to work 146½ koses was obtained at a cost of Rs. 5,600. Of this sum Government provided Rs. 2,300 and the well-owners Rs. 3,300 + the cooly labour required. Many wells which formerly contained little or no water have now sufficient to admit of five or six koses working continuously or better still an oil engine and pump. The Districts Local Boards of Kaira and Surat have bought boring sets for themselves, and I understand that the Baroda State has followed suit. Recently twenty new boring sets have been purchased to deal with the present deficiency of water in upper Gujarát, and this work will receive a great impetus. I see no reason why, with the aid of these boring tools, a very large proportion of upper Gujarát should not be effectively protected against famine by means of wells.

40. In the Deccan, tests with the automatic water-finder have been continued. It is disappointing that many of the people in whose land this machine gave indications of subsoil water have not yet taken the trouble to verify the indications. Dr. Mann, however, reports that out of 16 cases in which favourable indications were obtained a good supply of water was obtained in three cases, some water in some other cases, and in the rest no adequate excavation has yet been made. In no case has a favourable indication yet been found to be fallacious. Before we can speak with anything like certainty on the practical utility of this instrument more extensive trials will be necessary and a careful analysis of results made. I hope that it will be possible to put through this work during the present fair season. In connection with well-making in the Deccan several difficulties occur. In the deep black soils of the Krishna Valley and in parts of the Dhárwár District I have been told of the difficulty of preventing the wells falling in during construction, while at Khánápur (Belgaum District) the wells, when constructed, have a tendency to fall in and to fill up with mud brought up from below. Everywhere the cost of blasting with black powder in hard rock is heavy; and doubtless other difficulties exist. I should much like to see a man put on special duty to investigate the whole question of well-making.

41. Some interesting information on the subject of *tál* making has been collected during the past year; but the matter requires further study before we can speak with authority on the subject.

CHAPTER VI.

Publications.

42. The following publications have been issued since those mentioned in last year's report:—

Bulletins.

(1) Bulletin No. 40—Cultivation of Guavas near Poona, Dhárwár and Limbgaon.

(2) Bulletin No. 41—Groundnut in the Bombay Deccan.

(3) Bulletin No. 42—Note on Long Stapled Cotton in Sind.

(4) Bulletin No. 43—An Examination of the Seed Supply of the Broach District, Part II.

In the Press.

(5) Bulletin No. 44—Preliminary Study of the Red Rot of Sugarcane in the Bombay Presidency.

(6) Bulletin No. 45—Second Year's Experiments in the Treatment of Grape-vine Mildew in the Bombay Presidency.

(7) Bulletin No. 46—Seed Selection Series No. I, Broach Cotton.

(8) Bulletin No. 47—Sann Hemp.

(9) Bulletin No. 48—Poona Furnace.

(10) Bulletin No. 49—An Examination of the Seed Supply of the Ahmednagar District, Part I.

Leaflets (with vernacular versions).

(1) Leaflet No. 1—The Treatment of Grape-vine Mildew.

(2) Leaflet No. 2—Green Manuring with Tág or Sann Hemp.

In the Press.

(3) Leaflet No. 3—Cultiv ation of Tobacco.

(4) Leaflet No. 4—Rations for Cattle when Fodder is scarce.

(5) Leaflet No. 5—Emergency Fodders.

(6) Leaflet No. 6—The Preservation of Cattle Urine for Manure.

(7) Leaflet No. 7—Prickly-pear as Fodder.

43. It may not be considered out of place to mention a small Maráthi book which has been recently published by Mr. Mahadeo Narayan Deodhar, a landholder of Bárámati, explaining the good profits which may be obtained by a man who takes the trouble to level and bund his land, and who goes in for thorough cultivation. The book is sensible and practical and is a pleasing sign of the times.

CHAPTER VII.

Miscellaneous.

44. In conclusion I wish to express my appreciation at the work done by the officers of this Department. They have worked keenly and have not spared themselves in furthering the interests of the Department.

G. F. KEATINGE,
Director of Agriculture.

APPENDIX A.

No. 1876 OF 1911-12.

Poona Agricultural College;
Poona, August 22nd, 1911.

From

HAROLD H. MANN, D.Sc.,
Principal, Poona Agricultural College;

To

THE DIRECTOR OF AGRICULTURE, BOMBAY,
Poona.

Sir,

I have the honour to submit herewith the Report of the Poona Agricultural College for the year ending June 30th, 1911.

COLLEGE BUILDINGS.

2. The year under report is the third since the establishment of the College as a separate institution, and during the year the new main building of the College has been gradually occupied as it has been completed. At the end of the year it is practically complete, and the college work is now carried on in the full quarters which have been provided for it.

UNIVERSITY AGRICULTURAL COURSE.

3. The new agricultural course sanctioned by the University Senate in November 1909, has been applied to all classes at the College except the final year. It is on the whole satisfactory, and will come into full operation during the new current college year.

SHORT COURSE.

4. The short course, started two years ago, as an addition to the college work, is intended for farmers and landowners' sons. For this the sole qualifications were that the student should know English and have a fairly good general education. The training given is essentially a practical one, and is designed to give the men as good an acquaintance as possible with the best methods of agriculture applicable to our areas. There was at first some doubt as to whether there was a real demand for this course, but this is now dissipated, and the number of the suitable students tends to increase. The actual number of students attending the course has been as follows:—

1909-10	...	...	...	4
1910-11	...	...	...	12
1911-12	...	...	...	13

COLLEGE STAFF.

5. The Staff of the College has suffered two severe losses during the year. Mr. R. M. Dixon, B.A., Assistant Professor of Zoology and Entomology, died, after a few days' illness on November 26th, 1910. Mr. Dixon was an entomologist of very wide reputation in the special group of insects (the Rhyncota) whose study he had made his own. Mr. H. K. Mehta, M.A., B.Sc., Assistant Professor of Mathematics and Physics, left us in December 1910 to take up an appointment at the Elphinstone College, Bombay. His work during the three years he was with us was good, and, besides being a good mathematician and physicist, he proved himself an excellent teacher, and a very popular member of the staff. These two losses were replaced as follows:—

Mr. D. L. Sahasrabuddhe, B.Sc., L.Ag., acted as Assistant Professor of Physics from January 1st to the end of the session of 1910-11, and the position was permanently filled in May 1911 by the appointment of Mr. S. B. Butani, M.A., B.Sc. The position of Assistant Professor of Zoology and Entomology was allowed to lapse temporarily. Mr. R. S. Kasargode, L.Ag., was appointed as Lecturer in Entomology, and Mr. H. M. Chibber, M.A., of the Botanical Department undertakes the zoological teaching.

I was myself on privilege leave from March 25th to May 26th, and during this time my place was taken by Mr. W. Burns, Professor of Botany.

STUDENTS.

6. There is a slight drop in the number of students this year. The actual figures for the past five years have been as follows:—

	1907.	1908.	1909.	1910.	July 1911.
First year students	26	31	38	26	38
Second year students	38	39	26	33	24
Third year students	31	34	39	27	28
Short course students	...	...	4	12	13
Special and past Graduate students ..	...	...	1	2	1
Total ...	95	104	108	110	104

The students during the last three years included in the above table have come from the following parts of India:—

	1909.	1910.	1911.
Bombay Presidency . { Deccan	34	32	28
Bombay Presidency . { Southern Marátha Country and Konkan	32	35	34
Bombay Presidency . { Gujarát	17	18	23
Bombay Presidency . { Sind	9	6	4
Eastern Bengal and Assam	10	8	2
Central Provinces	...	...	1
Bengal	2	2	1
Central India	1	...	...
Nizam's Dominions	2	4	2
South India and Ceylon	1	5	9

Arranged according to the castes or classes from which they come, the students stand as follows:—

	1909.	1910.	1911.
Bráhmins	68	64	54
Maráthas	4	5	8
Lingáyats	5	6	5
Pátidárs (Gujarát)	4	5	4
Mahomedans	7	7	4
Pársis	1	2	4
Others	19	21	25

7. These students may be divided into three classes:—

(*a*) By far the larger number are qualified to study for, and intend to take, the agricultural degree of the Bombay University. The qualification on which the Bombay University insists, namely, the Previous Examination or its equivalent, is insisted on in the case of practically all students from the Bombay Presidency itself, and no student can, of course, appear for the University Agricultural degree without it.

(*b*) The second class consists of a few students who are not admissible to the University Examination, but who are taking the regular course along with the first class of students. These exceptions arose from the fact that it has been decided by Government to allow scholars to be received from Sind who have only passed the Matriculation Examination, provided that they were to receive the same course, and pass by the same standard as the University demands. Under this ruling students have been received every year since 1908. At the same time some applications were received from other Governments in India to be allowed to send students and from private persons outside the Presidency for admission to the College, where the applicants were not fully qualified for the University course. Where there was evidence to

show that such students could properly follow the course a small number have been admitted, as follows:—

	Admitted in 1908.	Admitted in 1909.	Admitted in 1910.	Admitted in 1911.
Bengal	1	...	...	...
Eastern Bengal and Assam	2	2	...	...
Nizam's Dominions	1	...	...	...
Sind	1	1	1	1
Bombay Presidency and Native States (subordinate)	...	...	2	3
Ceylon	...	...	2	...
Goa	...	...	...	1

(*c*) In the third place, we have the short course students already referred to. The places from which they come are as follows:—

Deccan	5
Southern Marátha Country	2
Gujarát	3
Nizam's Dominions	2
South India	1

As has already been stated, all these are the sons of landowners, and are taking the course for the sole purpose of putting their training to advantage on their own lands.

8. In addition to these classes, we are being occasionally requested to undertake the training of men for special purposes. At present we have such a man who is remaining here after graduation on behalf of the Rájkot State in order to acquire further experience particularly in horticulture. In such cases, we consider it part of our duty to try and fill any real need, where this can be done without interfering with ordinary college work.

University and other Examinations.

9. At the University Agricultural Examinations held in 1911, the number of candidates shown in the following list were presented, with results as indicated:—

	Sent up.	Passed.	Failed.	Percentage of passes.
First Examination in Agriculture	29	14	15	48·3
Second Examination in Agriculture	30	26	4	86·7
Bachelor of Agriculture Examination	22	20	2	90·9

The results are fairly satisfactory except in the first year's examination. The large percentage of failures in this year were chiefly due to failure in Mathematics on the one hand and in practical Agriculture on the other.

A special College Examination of the students (referred to above) not entitled to take the University Examination, was held in February and March 1911 with the following result:—

	Presented.	Passed.	Failed.
First Examination in Agriculture	4	4	...
Second Examination in Agriculture	3	1	2
Final Examination for Diploma in Agriculture ...	5	5	...

Scholarships.

10. The number of scholarships offered by Government at this College is now fifteen per annum. Candidates must have passed the Previous Examination of the Bombay University, and are selected by the Director of Agriculture in consultation with the Principal of the College. They are given by preference to the sons of cultivators and are awarded for the three years occupied by the course. The Director of Agriculture is empowered to extend the tenure of the scholarships to four years, and give a limited

number to Matriculates, who afterwards will join this College, for study in an Arts College. During the last four years those for students actually coming to this College have been awarded to candidates from the various districts as follows :—

	1908.	1909.	1910.	1911.
Deccan	2	...	2	5
Southern Marátha Country...	2	3	3	3
Gujarát	2	2	3	6
Konkan	2	1	2	1

11. The students from Sind are on a different basis. They are appointed by the Commissioner in Sind, and are not required to have passed the Previous Examination in every case. We have now at the College two such scholars from Sind in the second year, and one in the first year.

12. Other Governments and public bodies have utilised the College for the training of scholars. The number so admitted since 1908 has been as follows :—

Date of Entry.

	1908.	1909.	1910.	1911.
Government of Eastern Bengal and Assam ...	1	2	...	...
Government of Bengal	1	...	...	...
His Highness the Nizam's Government...	2	...	...	...
Baroda Government	...	2	...	...
Sángli State	...	...	1	...
Porbandar State	...	...	...	1
Kotah State	...	...	...	1
Vithalgadh State	...	...	...	1
Jámnagar State	...	...	...	1
Lingáyat Education Fund	1	3	1	...
Infanticide Fund, Northern Division	1	...	...	...

13. During the year a valuable new endowment has been made by an old friend of the College, Mr. Gulabdas Bhaidas Vakil of Surat, who has offered to give Rs. 2,500, the interest of which is to be used as a scholarship in commemoration of the Coronation of His Majesty King George V. The scholarship is to be given to the student who stands first in the second examination in agriculture of the University of Bombay. The thanks of all connected with the College are due to Mr. Gulabdas Bhaidas who has thus, for the second time, showed his practical sympathy with higher agricultural education.

Library.

14. The growth of the College library is very satisfactory. Four years ago it did not exist. On the separation from the College of Science being completed, a number of books (chiefly old and out of date) on Agriculture, Botany and Veterinary Science were handed over to us and formed a nucleus for the future. A special grant of Rs. 6,000 per annum was made in 1909 for library purposes, and has been continued during the two following years. With the funds thus made available and a number of presentations of books, the library has rapidly increased. The number of books in it at the end of the last three years has been as follows :—

1908-09	1,182
1909-10	2,780
1910-11	4,000

It is fairly consulted, not only by College students, but by gentlemen from all parts of the Presidency, and every effort is made to make it increasingly useful to the public.

College Quarters.

15. Some progress with regard to the provision of college quarters has been made during the past year. The design for the new buildings has been sanctioned, and the foundations have been put in and the building completed to the plinth level. It is hoped that one wing at any rate of this building may be completed before June 1912. In the meantime the objectionable arrangement continues by which our students are scattered over five different places in small buildings and bungalows taken for them.

Employment of Graduates.

16. The question of the employment of agricultural graduates becomes a more serious one every year. Naturally it is to be hoped that a continually increasing number of students will leave the College with the intention of managing their own lands. There is every sign of this being the case. At least thirteen or fourteen men (including the short course students) who have left the College in the present year intend to make use of their knowledge on their own land. But there remains, and must always remain, in Bombay a very large proportion of graduates who will be on the look-out for other openings.

In the present year the following appointments have been made from the Bombay graduates of the Agricultural College :—

Bombay Agricultural Department	9
Bombay Revenue Service	5
Baroda State	2
Other Native States	4
Eastern Bengal and Assam Agricultural Department.	3
Bengal Agricultural Department	1
Central Provinces Educational Department ...	1
Municipal and Private Bodies	2

Veterinary Dispensary.

17. The District Veterinary Dispensary at Bhámburda was taken over as a College Dispensary from August 1st, 1909, and the present report deals with the period from this date to June 30th, 1911. During this time 657 in-patients and 1,124 out-patients were treated or a total of 1,781. Of these 609 were agricultural animals. The daily average attendance of in-patients was 1·4 and of out-patients 7·5. Out of 1,781 cases, 721 were treated free. Among contagious diseases, there were eight cases of rabies in dogs, while one cow died of tick fever, a mare from Vágholi village died of anthrax (in the isolation ward), one horse suffering from Surra was destroyed, one pony affected with lymphangitis epizootica was destroyed under instructions from the Superintendent, Civil Veterinary Department, and a bullock suffering from black quarter died in the isolation ward. The Dispensary is not so popular as I should like to see it, especially among villagers. Efforts are being made, however, to increase its popularity by visits of the Veterinary staff in the villages near Poona and Kirkee.

Other Matters.

18. During the year under report the college undertook the responsibility, for the first time, of giving the short three weeks' course in agriculture which all the junior members of the Indian and Provincial Civil Service have to take. It was attended by seven members during the present year, and the teaching was undertaken by Professors Knight and Burns, and myself.

19. The staff on the whole have worked well, and are doing a considerable amount of research, and also of demonstration work in addition to their own duties. The College tends to become every year more and more of a centre for activity in connection with agricultural improvement and the dissemination of agricultural information. It has hence been visited by a constantly increasing number of landlords and other interested gentlemen on the one hand and on the other of large crowds of cultivators. Every effort is made to stimulate this public interest, as it is felt that the permanent success of the institution must largely depend on the extent to which it can be maintained.

I have the honour to be,

Sir,

Your most obedient servant,

HAROLD H. MANN,

Principal.

APPENDIX B.

Account of The Vernacular Agricultural School, Poona.

The Vernacular Agricultural School has been established as an experiment, whose object was to give a thoroughly practical Agricultural training to boys who belonged to good substantial village families whose object in life was to cultivate and manage their own land. With this conception in view it was opened in Poona in June 1910, with a course of two years, for boys by preference between the ages of 13 and 16 who had passed the fourth Maráthi Standard at least. It was placed under the control of the Principal of the Agricultural College, but was quite independent, with an Agricultural Graduate as Head Master, though a part of the College farm was used for the practical work of the boys.

With a scheme of which these are the general outlines, the School has now been carried on for over a year, and the time has come when a survey can be made of its success and its probable utility.

In the first year twenty-one boys joined the school, derived from the various Deccan Districts as follows :—

Poona	5 boys
Sátára	2 boys
Sholápur	1 boy
Ahmednagar	2 boys
Násik	7 boys
Kháudesh	1 boy
Ratnágiri	1 boy
Kolhápur State	1 boy
Nizam's Dominions	1 boy

Of these nine were Maráthas by caste, one was a Máli ; there were eight Bráhmins (several being the sons of Bráhmin village Pátils from Násik), and three others belonged to minor village castes. The ages varied from 13 to 18. All had passed the Maráthi fourth and some the Maráthi seventh standard.

The head master of the School was Mr. K. M. Pawar, B.Ag., a Marátha Agricultural Graduate, and a cultivator by birth and training, and he was assisted by a teacher detailed from the Educational Department for the purpose.

The scheme has been supported by a number of District Local Boards, and grants as follows have been made to the School for the year 1910-11 :—

East Khándesh	Rs. 200.
Poona	Rs. 225 (Rs. 5 per month for each boy in the School from the Poona District).
Násik	Rs. 250.
Ratnágiri	Rs. 60.

The curriculum was and is, frankly, an experiment. It involves at least half the working time being spent in the field whether in farm work, or in gardening, or in dairying or in other agricultural operations. The boys do practically all the work on the land allotted to their use, and they have almost entirely produced the food, with the exception of the grain and pulse, used by the School. The School work, more properly so called, consists of Arithmetic, more especially including farm accounts on the one hand, and mensuration applied to agricultural purposes on the other: nature study largely taught practically: writing and reading: Geography of India especially in relation to crops: the principles of Agriculture, and two new subjects: (1) 'village life', including sanitation, hygiene, and secondary occupations suitable for villages, and (2) what we call 'Citizenship', which includes questions of how to obtain money by *takávi*, by Co-operative Credit etc., and in addition the system of local and village Government in this part of India.

The School opened, as has already been stated, with twenty-one boys. After a short time which it required to accustom the boys to this new class of School work, it progressed well. The boys became very keen and fully entered into the spirit of the work while Mr. Pawar, the head master, threw himself into the work with great energy and developed the course which I had sketched out with much enthusiasm. The School was frequently visited by various officers of the Agricultural Department and particularly by Mr. P. C. Patil, L.Ag., Divisional Inspector of Agriculture, who has taken throughout the great interest in its progress. It was also visited frequently by the parents of some of the boys and by other villagers from several parts of the Deccan. They were, as a rule, very well satisfied with the way it was being conducted.

The school year was divided into two terms, the first of which closed in December, and the second at the commencement of April. At the end of each, an examination was held, conducted by Mr. P. C. Pátil, and his report is as follows :—

"I examined the boys in Agriculture and natural science twice during the course of the past year. I have often talked with them also in the School as well as on the farm. As it was the first year of the school, I made a point of visiting it frequently to see the progress it was making and help Mr. Pawar.

"I am of opinion that the boys take an interest in the farm work as well as in that done in class. In the course of the year they have considerably developed their knowledge and capacity of understanding.

"As a class they are well up in Agriculture and natural science. Most of them having the advantage of being born on farms, they manage bullocks and handle implements properly. As regards class work they are better in natural science than in the *theory* of Agriculture.

"Some of the boys are weak in Arithmetic and in the Maráthi language, and I suggest that special attention should be given to these subjects."

One boy did not return in the second term, as his general education was obviously too weak to enable him to follow the work. Among the others by far the weakest subject was Arithmetic, while nature study, though it was found interesting, was not very well grasped. After considering the whole results, it was decided to allow all the boys to proceed to the second year course. During the first year the school was conducted at a special bungalow at Bhámburda taken for the purpose, which was situated about ten minutes' walk from the farm, and which served as both School house and living house. The whole, in fact, formed a regular boarding school under the immediate eye of the head master who also lived on the premises.

The accounts of the school for this year are shown in the following balance sheet, which explains itself. The sale proceeds of farm stuff will appear small, but it must be remembered that practically the whole of the produce obtained was consumed by the school boys and by the stock kept. The amount of land entirely in the hands of the school for cultivation was between three and four acres. The expenditure includes the initial cost of starting the school :—

Receipts.	Rs.	a.	p.	*Expenses.*	Rs.	a.	p.
1. Poona Treasury (Government grant) ...	5,000	0	0	1. Establishment	1,079	0	0
2. Local Board, East Khándesh ...	200	0	0	2. Boarding charges	1,450	5	9
3. Local Board, Násik ...	250	0	0	3. Purchase of live stock ...	437	0	0
4. Local Board, Poona ...	225	0	0	4. Cultivation charges and building of sheds	874	0	0
5. Local Board, Ratnágiri ...	60	0	0	5. Feeding of stock	330	10	9
6. Sale proceeds of produce ...	21	3	0	6. Rent of school and sweeper charges	898	9	11
				6. School furniture and books ...	410	0	6
				8. Oil	44	12	6
				9. Stationery	55	9	11
				10. Tours of observation ...	41	6	6
				11. Travelling allowances to teachers	53	8	0
				12. Sale proceeds of produce, remitted to Poona Treasury ...	21	3	0
				13. Balance in hand	60	0	2
	5,756	3	0		5,756	3	0

The second year of the school commenced on June 10th, 1911. As we have now to provide for two classes of boys a first and a second year, a larger bungalow was required, and was secured in Kirkee Lodge, almost equally convenient for the college farm on which the bulk of the practical work is carried out. It is more convenient, also, for the Ganesh Khind Gardens where the gardening and horticultural work is taken which forms a large part of the second year's practical training. A large number of applications for admission were received, but true to the policy adopted at the commencement, apparently unsuitable boys were rigorously weeded out, and the present year now consists of eighteen boys, of much more even age than in the previous year and who will probably do very well. They have come from districts, as follows :—

Sátára	...	...	1 boy
Sholápur*	...	...	5 boys
Ahmednagar	...	...	4 boys
Násik	...	...	3 boys
East Khándesh	...	...	1 boy
Ratnágiri	...	...	1 boy
Kolhápur State	...	...	1 boy
Miraj State	...	...	1 boy
Sángli State	...	...	1 boy

They are all between the ages of 14 and 16 and as to caste are divided as follows:—

Marátha and Kunbis	...	...	12
Bráhmins	...	...	6

A large number of suitable boys could probably have been secured by more extensive advertisement than was adopted, but while the school is still in an experimental stage, it is probably wise to keep the numbers within such limits as will permit the close watching of work done and results obtained. It is becoming more evident that the site of the school had better be altered to a more purely rural one at as early a date as possible, though no visible evil effects of the proximity of a large city have been noticed. Every endeavour is made to keep the atmosphere of the school quite Agricultural, and I think that Mr. Pawar has succeeded in doing so to a very great degree. The sketch curriculum originally drawn out has proved good as a basis, and a copy is attached to the present report. It has now been filled in largely, as a result of the experience gained by the head master during the year.

On the whole, the school, in my opinion, has already indicated that we are on the right lines, and that schools like the present one fill a real need. We are continually being requested to establish a similar school in the Kánarese Districts and I think that the experience now gained, and that the fact that the school is appreciated and will evidently be more so, will justify this. The Director of Agriculture has, therefore, attached a very suitable Agricultural Graduate, Mr. R. Y. Hulkoti, B.Ag., from the Southern Marátha Country and a Reddy by caste, to the Maráthi School for training with a view to the establishment of such a school in the comparatively near future.

The school is, therefore, in my opinion already a decided success. Much of the credit of this is due to the way in which the head master Mr. Pawar has thrown himself into the work.

HAROLD H. MANN,
Principal.

DRAFT COURSE AT THE AGRICULTURAL SCHOOL.

School Work—16 hours per week.

I. *Arithmetic and Farm Accounts.*—Start at stage of 4th Vernacular Standard and work up through

1st year, 4 hours per week.
- (1) Addition of money.
- (2) Substraction of money.
- (3) Multiplication and division of money.
- (4) Weights and measures.
- (5) Reduction of weights and measures.
- (6) Calculating values of quantities of materials with given prices.

2nd year, 4 hours per week.
- (1) Interest.
- (2) Calculation of interest.
- (3) Discount.
- (4) Simple mensuration—
  - (*a*) Measurement of fields, regular and irregular with straight sides.
  - (*b*) Measurement of excavation and of masonry work. (This will be applied in practice in the outside hours.)
- (5) Farm Accounts as such.

II. *Geography and Physical Geography*—

1st year, 2 hours per week.
- (1) Seasons and causes of seasons.
- (2) Why rain falls, with local illustration.
- (3)
- (4) Local Geography of Bombay Presidency.

2nd year, 2 hours per week.
- (1) Relation of climate to crops.
- (2) Local Geography in relation to crops.

* At the time of writing four boys from Sholápur have not yet joined the school.

III. *Nature Study.*—

1st year 4 hours per week.

This course is intended to teach observation and will be carried out by means of actually hand work with leaves, germinating seed, wood, and so on, gradually advancing to more difficult things in the second year, like the inside of a sheep, etc.

It is one of the most important parts of the course, and should leave the boy with an experimental knowledge of—

2nd year 4 hours per week.

(1) Plant structure and adaptation.
(2) Common plants and their habits.
(3) Chief facts of plant physiology.
(4) Animal structure and habits—including insects, worms, etc.

IV. *Village Life.*—

(*a*) Sanitation.

1st year 1 hour per week.

(1) Cleanliness about village and houses.
(2) Latrines and their uses. How objectionable character of excreta can be removed and how it can then be used
(3) Care of purity of rivers and wells.
(4) Spread of diseases by water, etc.

(*b*) Secondary Occupations.

2nd year 1 hour per week.

(1) Teaching and training in eri silk.
(2) Other minor industries.

V. *Citizenship.*—

2nd year only 1 hour per week.

(1) Obtaining of money.
Saokari, Takávi, Co-operative credit.
(2) Local Government, District and Táluka Local Boards and their importance for agriculturists.

VI. *Writing and Reading.*—

1st year 3 hours per week. 2nd year 2 hours per week.

For *reading* use books like Bapat's on the care of cattle.
Possibly bits of Knight's agricultural reading books; but the actual books must be matters of thought.
Writing should be in the form of composition, letter writing, accounts of work done.

VII. *Principles of Agriculture.*—

1st year 2 hours per week. 2nd year 2 hours per week.

I have put a small number of hours into actual class teaching in agriculture, because I conceive that everything which can be taught in the field and out of doors will be taught there. The whole scheme of teaching might well follow the lines of Mr. Patil's suggested summary, but nearly all of this will be taught in the field.

Summary.

School work.	1st year.	2nd year.
(1) Arithmetic	4 hours.	4 hours.
(2) Writing and reading	3 hours.	2 hours.
(3) Geography and Physical Geography	2 hours.	2 hours.
(4) Nature study	4 hours.	4 hours.
(5) Village life and Sanitation ...	1 hour.	1 hour.
(6) Citizenship	...	1 hour.
(7) Agriculture	2 hours.	2 hours.

Outdoor and Practical work—16 hours per week.

(1) Conducting the work of the farm and their plots.	1½ hour per day. (9 hours per week.)
(2) Experiment in connection with nature study...	3 hours per week.
(3) Mensuration, field and building measurement, levelling	1 hour per week.
(4) Horticulture, including layering, budding, grafting	1 hour per week.
(5) Milking, care of milk, etc.	1 hour per week.
(6) Subsidiary things like poultry, etc. ...	1 hour per week.

In putting down so much time a week to each of these things I do not mean that this should be kept to with strictness. My idea is that the boys should be in batches, arranged so that they should spend this amount of time, in the total for the year, in each kind of work, and the batches should be arranged for convenience in teaching. Probably in the first year there would be only two batches, each in charge of one of the teachers or the fieldman.

The scheme for the outdoor work is put forward very tentatively, but wants discussion to get out the details.

APPENDIX C.

Summary of work done under the Deputy Director of Agriculture, Bombay Presidency, in 1910-11.

Cotton.

At Surat selection was continued in the best of the hybrid and selected cottons. It is now possible to narrow down the number of these cottons and for practical purposes there are only 3 left in. These are:

Selected Surat,
Hybrid 1018 P/G, and
Hybrid 1027-A., L. & F., with their sub-divisions.

These cottons have yielded well in the year under report and their ginning percentages are also satisfactory. On land in good condition selected Surat gave an outturn of 692 lbs. of seed cotton with a ginning percentage of 33·2. Hybrid 1027-A., L. & F., yielded at the rate of 575 lbs. and ginned at the rate of 33·8 and hybrid 1018 P/G yielded at the rate of 546 lbs. and ginned at the rate of 34·6.

Large samples, amounting to a bale of cotton, of these varieties grown by cultivators were sent to the Secretary of the international Federation of Master Cotton Spinners and Manufacturers Associations and were well reported upon, as shown below:—

Number of Bale.	Name of variety.	* Valuations of one Firm on 23rd September 1910.	† Valuations of another Firm on October 26th.
433	Selected Surat.	Fully good to fine Broach. Price 7*d.* ...	7¾*d.*
434	1018 P/G	Beautiful staple, could easily be spun to 20*s.* twist, 26*s.* weft. Price 6½*d.*	7½*d.*
435	1027-A., L. & F.	Could be used for weft, would spin up to 22/24. If mixed with American Cotton could be spun up to 30*s.* Price 6⅞*d.* for "spot".	7¼*d.*

* Middling American was quoted at 7·82*d.* per pound on 23rd September in Liverpool.

† Middling American quotation on October 26th was 7·88 and that of fine Broach 7½*d.* per pound in Liverpool.

When these bales were purchased in Surat the price of seed cotton was very high, amounting to Rs. 141 per bhár of 924 lbs., and after paying all expenses, including charges for ginning, pressing, transport, etc., there was a small loss of some Rs. 6 per bale owing to a small lot having to be sold at 7·25*d.*, although valued at higher rates; and if these bales had been sold at full rates there would only have been a margin of profit of some Rs. 8 per bale, but it should be remembered that the combined charge for ginning and pressing which amounted to Rs. 12-4-0 is higher than what the trade would pay. The profit however would not have been realized, had not the Liverpool quotations risen by more than one anna per pound between the date when the kapas was purchased at Surat and the cotton was sold in Liverpool.

In previous reports the unreliability of valuations made upon small hand samples of cotton, say 5 lbs., has been referred to and this has again been forcibly demonstrated in the year under report. An example will illustrate this point—

Cotton grown from	Bombay Millowners' Association.			Bombay Cotton Trade Association.	Through the Imperial Cotton Specialist.
	Counts.		Value per Candy of 784 lbs. in Rupees.		
	Warp.	Weft.			
	s.	*s.*			
Bázár seed	24	34	380	360	Equal to fine Broach good, but better in staple, Rs. 370.
Selected Surat I ...	16	24	360	385*	Equal to fine Surat good, but slightly inferior in staple, say midway between Broach and Surat, Rs. 375.

* This cotton has exceptionally good staple.

and it would seem that the only satisfactory method of ascertaining the amount of progress made from year to year is to have trial spinnings made; 50 lbs. of lint is said to be sufficient for such spinnings and this can be produced on half an acre.

In the year under report about 3,000 acres were sown with these cottons by neighbouring cultivators and the Department organized the sale of the seed cotton, all of which was sold by special arrangements to Motibhai Raghavji at rates ranging from 4 to 7½ per cent. higher than the rates prevailing for local seed cotton. The maximum figure was for farm grown cotton, while cultivator's cotton fetched rather less. The prices realised for the cotton lint ranged from Rs. 7 to 10 in the case of cultivator's produce and Rs. 15 per khandy (784 lbs.) in the case of farm cotton above the market rates for ordinary Surat cotton. The chief buyers were Messrs. Ralli Brothers, Volkart Brothers and Chunilal Sarabhai, an important millowner of Ahmedabad. In the beginning these firms purchased only small quantities, say 15 to 25 khandis for trial spinnings, but later on the demand became much stronger from the millowners so that the cotton was always sold in advance. The ginowner could have got higher prices for the cotton if he had held it up for a short time. The cotton grown from farm seed has now got the trade name of "Farm cotton" and is known in the bázár by that name: which is an important fact.

In the Southern Marátha Country the cotton districts may be divided into 3 tracts—

I. The Kumpta Tract,

II. The American Tract,

III. The Bagalkot Kumpta tract.

With regard to the first of these tracts the introduction of Broach cotton has proved successful where the soil is good and the early rains assured and it is probable that this cotton will hold its own against any improved form of Kumpta or other exotic in these favoured parts. Cambodia is perhaps the only exotic which offers any likelihood of successfully competing with Broach and Kumpta. These three cottons were grown under comparison in the year under report, but the results were somewhat interfered with owing to rain in the picking season. However Broach yielded at the rate of over 900 lbs. of seed cotton per acre, worth Rs. 128, while Kumpta yielded up to 870 lbs., worth Rs. 108, while on duplicate plots the yields were 626 and 413 lbs. of seed cotton, respectively. Cambodia suffered from red leaf blight and also from aphis and did not yield so well, giving 456 and 549 lbs. of seed cotton. The ginning percentages of these cottons were 24·62 per cent., 31 per cent., and 34·37 per cent. for Kumpta, Broach and Cambodia, respectively, which are below normal in all cases.

New Broach (Navsári) seed has ginned lower by about 2 per cent. than usual in the season under report.

In connection with the introduction of Broach (Navsári) cotton into the Southern Marátha Country, an auction sale was again organized by the Department for the sale of the produce. At last year's auction the prices obtained were a little disappointing, and hence many cultivators sold their Broach cotton privately before the auction for prices ranging from Rs. 180 to Rs. 195 per naga of 1,344 lbs., when the Kumpta rate was Rs. 155 to 165. A few growers of Broach cotton ginned their seed cotton and sold the lint. For these reasons a smaller quantity of seed cotton was sold at the auction than was expected. In all 170 nagas were received at the Government Depôt for sale, and this was carefully tested and graded according to ginning percentage into 6 grades. The top grade with a ginning percentage of 34 sold for Rs. 220, while the lowest grade with a ginning percentage below 29 per cent. realized Rs. 191 per naga of 1,344 lbs. and the Kumpta rate was Rs. 152—154 per naga. These prices show that the purchasers were willing to give higher rates than could be accounted for by the ginning percentages only, and it appears that the high class Broach cotton available in Gujarát is insufficient to meet the demands of the Ahmedabad mills, and in fact the whole of the seed cotton sold at the auction and by private dalals was this year bought by two millowners, *viz.*, Sirdar Sir Chinubhai Madhavlal of Ahmedabad and Mr. Ahmadbhoy Habibbhoy of Bombay, and the agents of these firms expressed their satisfaction with the superiority and cleanliness of this cotton and indicated their intention to again purchase all the available seed cotton next year. Some cultivators and petty dalals who had grown or purchased seed cotton ginned it and sold the cotton separately at 12 per cent. above the price of Kumta cotton, which was quoted at Rs. 132 when this Broach lint was disposed of for Rs. 148—150 per naga of 336 lbs.; which is very satisfactory, because hitherto it was believed that there was very little difference in value between Broach (Navsári) and Kumta lint and that the extra price for Broach was secured on account of its higher ginning percentage only.

Selected Kumta has yielded at the rate of 767 lbs. of kapas per acre and ginned at 25·25 per cent. when ordinary Kumpta has given 534 lbs. of kapas and a ginning percentage of 25·52 per cent. At Gokak this same selected Kumpta gave an outturn of 666 lbs. of seed cotton and 24·75 per cent. of lint, while ordinary Kumpta yielded at the rate of 510 lbs. of seed cotton per acre and ginned at 26·52 per cent.

A comparison between selected Kumpta seed and Bázár seed was made at Dhárwár in the year under report and resulted as follows:—

Seed.	Yield per acre in lbs. of seed cotton.	
	Sown by Surat drill.	Sown by local drill.
	Lbs. oz.	Lbs. oz.
Selected Kumpta seed	493 8	571 10
Bázár seed	427 10	506 10

The land was rather superior in the latter case.

At Gadag the most promising cotton is Madras Cambodia, which in the season under report (a poor one for cotton) yielded at the rate of 409 lbs., while local Dhárwár American only gave 221 lbs. of seed cotton per acre. The ginning percentages were 38·3 per cent. and 26·87 per cent., respectively.

A large sample of Cambodia cotton amounting to one bale of lint was sent to Liverpool last year and was very favourably reported upon. One firm reported as under:—"Very clean, almost as good as 'good middling American,' perhaps equal to staple Texas, price 7*d*". Another firm valued it at 7½*d*. with middling American quoted at 7·88*d*. The seed cotton was selling for Rs. 180 per naga of 1,344 lbs. when this bale was sent to Liverpool, and after paying all expenses, including ginning, pressing, transport, etc., there was a net gain of Rs. 26-10-8, although this bale being an odd lot was sold at 7·25*d* instead of 7½*d* but this large profit is partly due to a rise in Liverpool quotations between the date of buying the kapas at Gadag and selling the cotton in Liverpool.

In Khándesh, where the local cotton consists of a mixture of some half a dozen types, work has been in progress for some years in separating out these types and comparing their relative merits. The following results obtained in the year under report are therefore of great importance:—

Plot number.	Cotton Type.			Yield in lbs. per acre.	Cost of production in Rupees per acre.	Value of produce in Rupees per acre.	Profit in Rupees per acre.
	Name.	Description.		Seed cotton.			
		Lobing.	Flowering.	Lbs. oz.	Rs. a. p.	Rs. a. p.	Rs. a. p.
28	Roseum (N.R.) ...	Narrow ...	White ...	1,022 0	42 3 2	146 0 0	103 12 10
29	Roseum (N.R.E.) ...	Broad ...	Do. ...	943 0		134 11 0	92 8 2
30	Vera (N.V.) ...	Narrow ...	Yellow. ...	592 5		84 9 0	42 5 10
31	Malvinsis (N.V.M.) .	Broad ...	Do. ...	593 0		84 11 4	42 8 2

Note.—The land was ploughed with an iron plough and manured at the rate of 5 tons farm yard mauure per acre.

The Millowners' Association report Roseum (N. R.) to be fit for spinning 10*s*. warp and 16*s*. weft and Malvensis 20*s*. warp and 28*s*. weft and the Cotton Trades Association valued* these cottons at Rs. 315 and Rs. 330 respectively but other valuations assign a higher relative value to Malvinsis by Rs. 15 or Rs. 25 per khandy.

At Dhulia Roseum cotton continues to give excellent results as may be seen from the above tabulated figures. Its great value lies in its heavy yielding, high ginning, bright colour and extreme earliness. It will be seen that Malvensis, which is the best fibred constituent in the Khándesh mixture, was reported to be suitable for spinning 20*s*. warp and 28*s*. weft by the Millowners' Association and valued at Rs. 330 by the Cotton Trades Association.

This however is a low ginning cotton giving 25·1 per cent., while Roseum gave 37·4 per cent. in the year under report.

A new hybrid has been produced at Dhulia which offers considerable promise. It is a cross between Comilla and Bani and has now reached the second generation. Its ginning percentage was 36 in the present year and it was reported to be suitable for spinning 20*s*. warp and 28*s*. weft by the Millowners' Association, while the cotton Trades Association valued it at 360 to 365 (Fine Broach 360) per khandy and remarked that although the fibre was rough it was of good staple. This hybrid is being selected according to Mendelian principles. Comilla cotton is famous for its very high ginning percentage but rough fibre, while Bani is equally famous for its very low ginning percentage but excellent staple and silky feel.

* Fine Broach was taken at Rs. 360 per khandy.

Buri cotton did well at Dhulia in the year under report, which however was a very good season as regards rainfall, and it is probable that in a season of only moderate or short rainfall this variety would not do nearly so well. Moreover, this variety is subject to being damaged by boll worm. This cotton moreover gave its first picking when Khándesh gave its second and this was also the case with Cambodia cotton, which did not do so well as Buri, as may be seen from the following summary:—

Name of cotton.	Yield of seed cotton in lbs. per acre.	
	Lbs.	oz.
Buri	891	14
Khándesh	781	14
Cambodia	433	12

Promising results have been obtained at Nadiád with Buri cotton in the year under report and to a lesser degree with Cambodia also. There are two limiting factors in cotton cultivation in northern Guzerát, (*a*) the necessity of irrigation to supplement the monsoon rain and (*b*) the liability of frost in January. Results obtained show that excellent outturns of high quality cottons can be produced on Nadiád (sandy goradu) soil when there are irrigation facilities at the end of the hot weather with which to establish the crop before the monsoon sets in and thus allow it to take full advantage of the rains. Thus hybrid 1367 (a cross between Bourbon and Texas) sown in May yielded 536 lbs. of kapas per acre, valued at Rs. 395 per khandy of 784 lbs. with fine Broach at Rs. 360. This yield was obtained prior to the end of January and would have been more but for the frost which killed off all the growing cotton. The same variety sown in July had only yielded 40 lbs. of kapas per acre when the crop was destroyed by frost. Bourbon cotton established in this way continues to give excellent outturns for 2 or 3 years without requiring any irrigation in the second or third year or after the monsoon in the first year. A second year's Bourbon plot yielded in the year under report at the rate of 1,392 lbs. of kapas before the end of January, otherwise there would have been a still heavier yield; and it was sold to the Industrial Mills at Broach for Rs. 343 per khandy when Surat Broach was selling at Rs. 320 and the purchaser reported that the staple was good and could spin 40*s.* to 50*s.* while another variety of Bourbon was reported "Staple good, colour very good, can spin upto 50*s.* very well"; but the Millowners' Association in Bombay reported on a (5 lbs.) sample of this cotton as being suitable for 30s. and the cotton Trades Association of Bombay valued it equal to Navsári.

Buri and Cambodia were grown under two conditions (*a*) sown in May with irrigation, (*b*) sown July without irrigation. In the former case the Buri yielded at the rate of 1,024 lbs. of kapas per acre and the lint was valued at Rs. 367 with Fine Broach at Rs. 360 by the Bombay Cotton Trades Association, who reported it to be "Off fine in class but good staple." The Cambodia yielded at the rate of 688 lbs. of kapas per acre and the cotton was valued at Rs. 370 with the same remarks as for Buri.

When sown in July the Buri gave an outturn of 688 lbs. of kapas and the Cambodia 440 lbs.

We may therefore conclude that these two cottons can be grown as dry crops in a good season at Nadiád, but that where irrigation facilities exist in the month of May and June these varieties should then be sown. As wells are very numerous in Northern Guzerát it should not prove impracticable to provide the little irrigation required to establish these cottons, and once established no further irrigation is required.

In addition to the foregoing there is a large amount of new work in progress at Surat, Dhárwár and Nadiád. This consists in the production of a number of new hybrids and of the individual selection of specially superior plants with the object of raising up new strains from the best of these. Perhaps the most suggestive work is the production of hybrids between Cambodia cotton and soft Peruvian. The former is an annual with the characteristic of a very high ginning percentage and is the most promising exotic cotton, possessing the American fibre, in the Bombay Presidency, but its staple is not long, being less than an inch. Soft Peruvian on the other hand is a perennial cotton possessing a very long staple and low ginning percentage. The object in making these hybrids is to try and evolve a cotton retaining the good characters associated with Cambodia together with a longer staple.

Wheat.

Several varieties of wheat are under trial at Dohad, which grows very excellent wheat. The highest yield obtained in the year under report was 2,100 lbs. grain and 3,282 lbs. of chaff by Australian No. 27, a Punjáb wheat, taken after a crop of sann grown in the rains.

as against 1,212·5 and 2,534 by the local Pissi (a soft white wheat), but the grain of the latter was very plump and well fed and valued at Rs. 4-15-0 per cwt.

Shet Párner and Bansi wheats also compared well with the local Dhola Katha (a hard yellow wheat) and were valued at Rs. 5 and Rs. 5-1-0, when Dhola Katha was valued at Rs. 4-11-0 per cwt. by Messrs. Ralli Brothers. Hybrid of Nagpur × Muzaffarnagar gave over twice the outurn of local Wagia (a soft red wheat), but the sample was not as good as last year, being described as "Soft white style of Jubbulpore pissi, rather poor owing to shrivelled grains."

The profits per acre at Dohad were not so large as usual owing to the low prices prevailing for wheat.

Bansi wheat gave good results as a dry crop at Dhárwár yielding roughly 850 lbs. of grain per acre worth Rs. 45 and costing Rs. 13-10-0 per acre to produce. The best crop of red local wheat (Navalgund) was 612 lbs. per acre, worth Rs. 34. These wheats were valued at Rs. 4-10-6 and Rs. 4-7-6 per cwt., respectively.

At Gadag, Shet Párner wheat from seed newly introduced from Manjri yielded at the rate of 496 lbs. of grain and 696 lbs. of chaff per acre, which was relatively a high outturn; but this variety is rather later in maturing than local red wheat. A sample of Shet Párner wheat which had been grown at Gadag for two seasons was valued at Rs. 5-5-0 per cwt. by Messrs. Ralli Brothers while local Bagewadi (wheat) was valued at Rs. 4-9-0 per cwt.

Mundi is the commonly cultivated irrigated variety of wheat in Khándesh. For the last 2 or 3 years a comparison between this variety and Bansi, a dry crop variety has been conducted. In the season under report Bansi has given much the best results under irrigation:—

Name of variety.	Yield per acre in lbs.		Cost of production in Rupees per acre.	Value of produce in Rupees per acre.	Profit in Rupees per acre.
	Grain.	Chaff.			
	Lbs. oz.	Lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.
Mundi	1,827 5	2,240	99 3 4	113 12 0	14 8 8
Bansi	2,012 5	2,715	99 3 4	126 8 7	27 5 3

Shet Párner wheat grown as an irrigated crop at Dhulia was valued at Rs. 5-7-0 per cwt. and described as a very fine sample, and it is interesting to note that the sample was free from "spotted" grains.

Experiments in selection and hybridization are being carefully continued on the Dohad, Nadiád, Dhulia, Dhárwár and Gadag farms.

Jowar.

At Dhulia the two local jowars Gudgi and Mothi were compared with Egyptian white jowar, which is a very early variety and which therefore might prove suitable in Khándesh. Gudgi is a small grained but early variety, while Mothi though large grained is later than Gudgi and therefore does best in a season of good rainfall, and this was the experience of the year under report. The results (dry crop) obtained were as follows:—

Name of variety.	Yield per acre in lbs.			Profit in Rupees per acre.
	Grain.	Kirbi.	Chaff.	
	Lbs.	Lbs.	Lbs.	Rs. a. p.
Motti	1,720	4,220	594	40 7 0
Gudgi	1,356	5,848	336	36 14 0
Egyptian white	597	3,652	506	8 10 4

The low yield of Egyptian white is ascribed to the lack of moisture when the grain was setting. The high yields of kirbi especially in Gudgi will be noticed.

Trials with combined grain and fodder jowars at Dhárwár resulted in Handimasadi topping the list with 1,200 lbs. of grain and 3,800 lbs. of kirbi and 250 lbs. of chaff worth Rs. 62 and costing Rs. 24 per acre to produce. Sadgar gave a heavier yield of kirbi

(4,340 lbs.) but less grain (844 lbs.). Fulgar yellow also gave good results. Incidentally it was observed that a drill of 12″ gives better fodder results than a drill of 15″; in the former case the kirbi stems are thinner and of better quality. Trials with pure fodder varieties, such as Sundhia, Nilva and Utavli, did not give good results, the yields being very poor.

Trials with local grain, jowars and Chapti and Perio varieties from Guzerát resulted in local Fulgar White, giving much the best yields, amounting to 11 or 1,200 lbs. per acre, while the Guzerát varieties only gave 800 lbs. per acre; but the latter had some advantage in yield of kirbi, which in the case of Perio amounted to 5,000 lbs. per acre. The two Guzerát varieties suffered considerably from grasshoppers.

Selection in jowár is being systematically carried on at Surat, Dhárwár and Dhulia.

Tobacco.

A number of new varieties of tobacco of the cigarette class have been obtained from America and Turkey for trial at Nadiád, because it is believed that these varieties may have some chance of success under the conditions prevailing at Nadiád; and there is now an unlimited demand for cheap cigarettes in India. Experiments were also commenced in the year under report to determine whether potash manuring would remedy the great defect of Nadiád tobacco leaf, *viz.*, its extremely low potash content, and therefore bad burning properties. The potash has been supplied from two sources, (*a*) sulphate of potash, and (*b*) wood ashes.

Groundnuts.

Groundnuts as a dry crop have given excellent results at Kelgeri on red soil in the season under report. Spanish peanut yielded at the rate of 3,340 lbs. of nuts per acre and Small Japanese gave an outturn of 2,516 lbs. per acre. The vegetative growth was very profuse, especially in small Japanese, which attained a height of 1½ feet. Over 2,009 lbs. of dry haulms per acre was produced by small Japanese.

At Dhárwár all varieties can be grown as a dry crop; in the year under report Mozambique yielded at the rate of 2,580 lbs. of nuts and 1,610 lbs. of haulms per acre worth Rs. 137 and costing Rs. 53 per acre to produce. Virginia gave 2,510 lbs. of nuts and several other varieties yielded over 2,000 lbs. of nuts per acre. An experiment to ascertain the best seed rate for different varieties of groundnuts was partially vitiated by a severe attack of ticca disease which broke out at the end of August, but the indications are that for varieties like Tamboo, which do not spread much, a seed rate of some 80 lbs. of kernels per acre is necessary, while for varieties with a greater spreading habit a seed rate of 60 lbs. is sufficient.

Experiments with Spanish peanut as a dry crop at Surat resulted in a yield of 948 lbs. of nuts and 6,006 lbs. of chaff per acre when the seed rate was 50 lbs. of kernels per acre. Lower seed rates gave much smaller returns; and it is proposed to experiment with higher seed rates next year. The value of the crop was Rs. 89 and the cost of production Rs. 59, so that the net profit was Rs. 30 per acre. Spanish groundnuts were also grown in alternate rows with cotton and also with jowár. Owing to second sowings the cotton-groundnut combination did not prove a success, while that of jowár and groundnuts left a slightly lower profit than jowár alone. Jackals however are to some extent an obstacle in the way of groundnut cultivation at Surat. Spanish peanut grown as a dry crop at Dhulia gave a yield of 2,176 lbs. of nuts and a like yield of chaff and left a nett profit of Rs. 53-10-1 per acre. The kernels of this variety were found to have an oil percentage of 45·16, which is a falling off on last year's results, and may indicate that this variety degenerates in Khándesh. This crop was planted 12″ × 6″ but comparative results with closer planting indicate that that distance is too great. This crop is being taken up on a limited scale in Khándesh.

Groundnuts offer some prospect of success in the Panch Mahál but require to be sown on fairly high lying land as water logging is very hurtful to this crop. Senegal as a dry crop gave an outturn of 2,480 lbs. of nuts and 11,592 lbs. of haulms per acre in the year under report. Cotton and groundnuts in alternate rows did not give good results in the year under report, and a new system of growing these two crops together will be tried next season. Jowár and groundnuts in alternate rows were also not satisfactory.

Til.

Selection work in this crop is being continued on several farms. At Surat the seed of one plant found in 1909-10 possessing 12-celled capsules was sown separately and the plants turned out curiously malformed in that the stem of each plant assumed a flattened form with corrugations generally corresponding to the number of cells. Each plant also bore a tuft of leaves at the top of the stem with a malformed inflorescence and hence it would seem that 12-celled capsules indicate an abnormal condition.

Gram.

At Dhárwár gram did very well and the black seeded variety again topped the list as may be seen from the following list :—

Variety.	Grain in lbs. per acre.	Chaff in lbs. per acre.
	Lbs.	Lbs. oz.
Local black	830	557 8
Local yellow	710	450 0
Local brown	710	420 0
Broach	535	380 0

In practice the 3 local varieties are grown mixed together and hence the advantage of separating them is apparent.

At Dohad dry crop local gram yielded upto 982 lbs. of grain per acre.

Tillage and cultural Experiments.

Ploughing with the iron plough in preparation for the tobacco crop at Nadiád has increased the yield by about 5 per cent. and left an increased net profit of roughly Rs. 7-8-0 per acre as may be seen from the following statement :—

	Yield in lbs. per acre of dry leaf.	Value of produce per acre in Rupees.	Cost of production per acre in Rupees.
	Acre.	Rs.	Rs.
Country plough	2,070	188 2 0	114 1 0
Iron plough	2,178	197 15 0	116 5 0

Deep ploughing for some of the staple crops at Nadiád, such as Bájri, Kodra and Sundhia, has not yielded definite results in the year under report, largely owing to the unfavourable season for these crops.

At Surat deep ploughing after the beginning of the monsoon has been compared with shallow cultivation (harrowing) for the last five years on both cotton and jowár. Bad results have generally been obtained with cotton on deep ploughed plots owing to the difficulty of getting a good germination on recently ploughed land. Better results have been obtained with jowár, as may be seen from the following figures :—

	Yield in lbs. per acre in 1910-11.		Average yield in lbs. per acre for the 5 years 1906—1910.		Average value of produce in Rupees.	Average cost of production in Rupees.	Average net profit in Rupees.
	Grain.	Kirbi.	Grain.	Kirbi.			
	Lbs.	Lbs.	Lbs.	Lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.
Deep cultivation ...	1,264	3,614	1,067	2,214	55 14 3	20 8 8	35 5 7
Shallow cultivation .	1,036	3,002	978	2,085	42 6 6	19 3 4	23 3 2

Similarly in another experiment in which the ploughing was done in the fair season soon after the preceding crop was harvested the yield of the deep ploughed plot exceeded that of the shallow cultivated plot by 233 lbs. of grain and 400 lbs. of kirbi per acre when the average yield was 1,000 lbs. of grain per acre.

At Dhulia deep ploughing with the iron plough in preparation for cotton has not given such good results as shallow ploughing with the country plough, but the rotation crop of jowár for which the land was only harrowed in the year under report shows a much greater outturn on the plot deep ploughed last year for cotton than on the plot which was shallow ploughed. The respective net profits on these two plots in the year under report were Rs. 58 and Rs. 34 approximately :—

Cotton.				Jowár.					
Deep ploughed.		Shallow ploughed.		Deep ploughed.			Shallow ploughed.		
Seed cotton.	Stalks.	Seed cotton.	Stalks.	Grain.	Kirbi.	Chaff.	Grain.	Kirbi.	Chaff.
Lbs. 385	Lbs. 405	Lbs. 421	Lbs. 505	Lbs. 1,403	Lbs. 6,655	Lbs. 410	Lbs. 1,100	Lbs. 5,410	Lbs. 310

At Gadag deep ploughing with the iron plough has given good results with rabi jowár, as may be seen from the following figures :—

Tillage.	Yield in lbs. per acre.		
	Grain.	Chaff.	Kirbi.
	Lbs.	Lbs.	Lbs.
A—Deep ploughing	618·5	85·5	1,623·0
B—Shallow cultivation	536·0	72·75	1,465·5

In the case of A the land was ploughed in May with the gallows plough and subsequently harrowed 13 times before sowing.

In the case of B the local practice was followed of harrowing the land only 5 to 6 times before sowing.

The seed was sown in the second week of November and it was observed that in spite of the number of harrowings the germination on the ploughed plot was irregular but the crop on these plots became taller and looked more vigorous than that on the shallow cultivated plots.

A similar experiment at Gadag on wheat resulted in the deep ploughed plots yielding rather higher outturns than the harrowed plots. In this case the germination was regular and uniform on both sets of plots but about two months after sowing the crop on the deep ploughed area assumed a somewhat more vigorous growth than that on the harrowed area. The yields obtained were as follows :—

	Yield per acre in lbs.	
	Grain.	Chaff.
	Lbs.	Lbs.
Deep ploughed	297	463·5
Harrowed	280	435

Deep ploughing for cotton at Gadag has not yielded definite results.

In the Panch Mahâls sowing is done by dropping the seed in the furrow made by the country plough. A comparison was made on the Dohad farm between this method and drilling. The crop sown was maize and the results obtained were :—

Method of sowing.	Yield in lbs.		Value of produce in Rupees.	Cost of production in Rupees.	Profit in Rupees.
	Grain.	Stalks.			
	Lbs.	Lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.
Country method	1,812	1,554	47 11 8	24 12 4	22 15 4
Drilled	2,144	2,113	56 14 5	33 2 4	23 12 1

which confirms last year's results.

Similarly an experiment with cotton was made and resulted as follows :—

Method of sowing.	Yield in lbs.	
	Seed cotton.	Stalks.
	Lbs.	Lbs.
*Country method	255	651
Drilled	415	1,013

* Care was taken with this method not to let the seed drop deeper than 2 inches.

An experiment in thinning Roseum cotton was conducted at Dhulia. This variety has a tall upright habit of growth with very little lateral branching. The crop was accordingly thinned to 12″ and 9″, while there was a control plot kept unthinned and the experiment was conducted in triplicate. The results obtained were uniformly unfavourable to thinning but this probably means that 9″ is too great a distance to thin rather than that no thinning should be done. The experiment will be revised and repeated in 1911-12.

Similar results were obtained with bájri.

One of the worst weeds on irrigated land is Chirdo (Cyperus rotundus). At Dohad in the hot weather an area of 18 gunthas (20 gunthas equal to half an acre) was ploughed with the small turn wrest plough and a gang of children put on to gather up the chirdo bulbs. The amount collected weighed 44 lbs. dry weight including leaves and in the season under report there was very little chirdo noticed on this land.

The comparative independence of black cotton soil as regards manuring when the land is kept in well tilled and in clean condition was again demonstrated at Surat in the year under report, when on land which has not been manured for 14 years the following yields were obtained :—

Crop.	Grain per acre in lbs.	Kirbi or stalks per acre in lbs.
	Lbs.	Lbs.
Jowár	1,112·5	2,428
Cotton	350	662

At Dohad an area of some 20 acres which had previously been rented out for a nominal rent and which had got into a very jungly condition was successfully reclaimed and got into good condition in the year under report. The method consisted of first digging out all scrub growth, then ploughing the whole area with an iron plough in the hot weather followed by a crop of sann ploughed under in the rains. Fair crops of wheat and gram were raised in the cold weather and now the land is in good clean condition. This work has impressed the neighbouring cultivators, much of whose land has also got into foul condition, and one man has already commenced to improve his land in the same way.

Manurial Experiments.

Experiments to find an alternative bulky manure for Farm yard manure at Surat have revealed the value of poudrette and mohwra refuse. The results obtained in the year under report are summarized below. The manures are applied every second year to the cotton crop in the two-year rotation cotton-jowár :—

Name of manure.	Quantity in tons per acre.	Average yield in lbs. per acre		Average value of produce in Rupees per acre.	Average cost of production in Rupees per acre.	Average profit in Rupees per acre.
		Grain.	Kirbi.			
		JOWAR.				
		Lbs.	Lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.
Mohwra refuse ...	5 tons in previous year to cotton.	935	1,669	35 2 5	14 11 11	20 6 6
Farm yard manure ...	Do. ...	765	1,305	28 13 8	14 11 11	14 1 9
Poudrette	Do. ...	1,057	2,237	40 14 7	14 11 11	26 2 8
Nil	.....	592	1,132	23 4 6	14 11 11	8 8 7
		COTTON.				
		Seed cotton.	Stalks.			
Mohwra refuse ...	5 tons per acre.	366	645	59 0 10	19 9 7	39 7 3
Farm yard manure ...	Do. ...	393	640	63 11 7	24 6 1	39 5 6
Poudrette	Do. ...	466	1,000	75 7 6	27 12 3	47 11 3
Nil	.....	303	570	48 12 10	10 14 3	37 14 7

Rotted cactus, town sweepings and tank mud were also tried, but although the first two named manures have increased the yields of cotton and jowár, they do not leave a net profit, while tank mud has produced little or no effect on either of these crops, but introduces a host of weeds. The effect of poudrette will be noticed both on the grain and the fodder as well as on the cotton and that mohwra refuse is fully as good as farm yard manure from a financial point of view, but its price might go up if its manurial value became fully realized, for its present price of Re. 1 per ton must be regarded as very low.

At Dhárwár poudrette applied direct to the jowár crop has given good results as may be gathered from the following figures, which are an average of duplicate plots :—

Name of manure.	Quantity in tons per acre.	Yield in lbs. per acre.			Value of produce in Rupees per acre.	Cost of production in Rupees per acre.	Nett profit in Rupees per acre.
		Grain.	Chaff.	Kirbi.			
		Lbs. ozs.	Lbs.	Lbs	Rs. a. p.	Rs. a. p.	Rs. a. p.
Poudrette	5	1,139 6	895	5,360	73 11 7	66 2 13¾	47 9 5¼
Farm yard manure .	5	1,024 12	420	2,885	52 12 9	26 2 13¾	26 10 7
Nil	...	857 8	435	2,100	43 6 10	16 2 13¾	22 4 8¼

The residual effect of crude night soil at Surat applied 7 years ago continues to make itself strongly felt. Jowár was the crop taken in the year under report. The results obtained are summarized below :—

Original manurial treatment.	Yield in lbs. per acre in 1910-11.		Average yield of Jowár for 4 years.		Average value of produce for 4 years.	Average cost of manure in Rupees per acre.	Difference of columns 6 and 7.
	Grain.	Kirbi.	Grain.	Kirbi.			
1	2	3	4	5	6	7	8
	Lbs.	Lbs.	Lbs.	Lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.
84½ cart-loads of night soil applied in beds in 1904-05.	1,420	2,878	1,733	4,447	69 0 0	15 0 0	54 0 0
No manure in 1904-05 but 20 cart-loads of farm yard manure in 1905-06.	844	1,475	1,016	2,596	40 6 0	5 14 0	34 8 0
40 cart-loads of farm yard manure in 1904-05.	1,067	1,813	1,231	2,927	48 4 0	8 1 0	40 3 0
84½ cart-loads of night soil applied in trenches in 1904-05.	1,219	2,336	1,486	4,023	59 13 0	15 0 0	44 13 0

At Gadag the residual effect of farm yard manure applied to the preceding cotton crop was well demonstrated on rabi jowár and wheat in the year under report, as may be seen from the following figures:—

Rabi Jowár.

Treatment of previous crop of cotton.	Yield in lbs. per area.		
	Grain.	Chaff.	Kirbi.
Manured	698·0	90·5	1,811·5
Not manured	456·5	67·75	1,277
Wheat.			
Manured	375·5	551·0	.....
Not manured	201·5	347·5	.....

Castor cake (600 lbs.) applied as a supplementary manure to farm yard manure (20,000 lbs.) on tobacco continues to give good results at Nadiád, increasing the yield of leaf by 8 to 9 per cent. over that on plots manured with 30,000 lbs. of farm yard manure alone. The extra cost of the manure was roughly Rs. 2-8-0 and the gross profit Rs. 16-8-0, leaving a net profit of Rs. 14 per acre.

In Khándesh experiments with the combination of sodium nitrate and superphosphates in addition to farm yard manure applied at the rate of 10 cart-loads per acre has given good results. The value of the artificials amounted to Rs. 21-3-3 per acre and the seed cotton was valued at Rs. 22 per 144 lbs. for the purpose of estimating the profit. The results obtained are tabulated below :—

Cotton crop treated with	Average yield per acre in lbs. of seed cotton.	Value of produce per acre in Rupees.	Cost of special manure per acre in Rupees.	Difference between columns 3 and 4.	Profit over the plot treated with farm yar manure.
1	2	3	4	5	6
		Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
Manured with farm yard manure + artificial	689	105 4 3	21 3 3	84 1 0	16 1 3
Manured with farm yard manure alone	445	67 15 9	...	67 15 9	

Rotational Experiments.

At Dhulia an experiment has been in progress for the last 4 years to determine the most profitable 2-year rotation for cotton, and the conclusion arrived at 2 years ago, and partially confirmed last year, is again confirmed in the year under report, and that is that til not only leaves the greatest net profit but also prepares the way for the highest yield of cotton.

The great feature of the results obtained in the season under report has been the phenomenally high outturns of cotton. Yield of roughly 1,500 lbs. of kapas (dry crop) per acre has been obtained on the plot rotated with til.

Another remarkable point brought out is the excellent crops of cotton which can be raised year after year on the same land without manure and without rotation in West Khándesh. In the season under report the plot which had been treated in this way for the last 4 years yielded at the rate of 831 lbs. of seed cotton per acre worth roughly Rs. 119, while the cost of cultivation was only Rs. 27-2-4.

The practice of cultivators taking several continuous crops of cotton on the same land when the price of cotton is high is therefore not unjustifiable. In the following statement the results obtained in the year under report are summarized, from which it will be seen that a gross return of Rs. 200 approximately has been secured from these plots, leaving a net profit of more than Rs. 150 (exclusive of rent and taxes).

Roseum cotton was grown throughout this experiment.

Rotation.	Cotton,					Rotation Crop.					
	Yield per acre in lbs.		Cost of production in Rupees per acre.	Value of produce in Rupees per acre.	Profit in Rupees per acre.	Name of crop.	Yield in lbs. per acre.		Cost of production in Rupees per acre.	Value of produce in Rupees per acre.	Profit or Loss in Rupees per acre.
	Seed cotton.	Stalks.					Seed cotton.	Stalks.			
	Lbs.	Lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.		Lbs.	Lbs.	Rs a. p.	Rs. a. p.	Rs. a. p.
I ...	1,371½	1,640	47 7 11	195 14 2	147 6 3	Fallow ...	.....	...	6 8 0	...	6 8 0
II ...	1,375	1,495	45 7 11	196 6 11	150 15 0	Udid ...	731·25	1,720 (chaff)	23 12 8	41 9 0	17 12 4
III ...	1,490	1,550	45 7 11	212 13 10	167 5 11	Til ...	453·75	820	10 9 8	47 4 3	36 10 7
IV ...	1,207 11	1,150	45 7 11	172 13 0	127 5 1	Bajri ...	728·75	2,515	27 7 0	36 5 10	12 14 10
V ...	831 6	1,104	27 2 4	118 11 3	91 8 11	.....	.....	...	.....	...	...
VI ...	1,048 12	1,345	36 0 4	149 13 1	113 12 9	.....	.....	...	.....	...	...

Notes 1.—In rotations I to IV 3 tons farm yard manure are applied every second year to the cotton crop.
" 2.—In rotation V cotton is taken continuously without manure or rotation.
" 3.—In rotation VI cotton is taken continuously but manured at the rate of 2 tons farm yard manure yearly.
" 4.—The land is ploughed every year in the case of rotations V and VI.

At Surat a bumper crop of jowár was produced on a plot which had been sown with groundnuts in 1909-10. No manure was applied in the year under report but the yield was 2,588 lbs. of grain per acre and 5,933 lbs. of fodder, leaving a nett profit of Rs. 77 per acre, while a similar plot which had a dressing of 5 tons of poudrette per acre gave the exceptional outturn (for dry crop) of 2,692 lbs. of grain and 7,250 lbs. of fodder per acre.

The best rotation for jowár on the Dhárwár Farm appears to be gram which confirms last year's observations. The yield of jowár obtained in the year under report on plots sown with gram last year was at the rate of 1,564 lbs. of grain per acre worth Rs. 77 and costing Rs. 21 to produce.

Preventive Entomology and Mycology.

There is a compact block of some 5,000 acres of rice land in the vicinity of Belgaum and for some years past the crop has been badly damaged by a certain grasshopper (Hieroglyphus furcifer). In 1909-10 this Department took the matter up on a small scale and obtained a good deal of useful information which enabled the necessary estimates to be made for 1910-11; but the pest had increased sixfold and hence the requirements were underestimated. Previous experience had shown that the only practicable measures that could be taken against this pest were to net the hoppers in long rectangular shaped nets dragged across the field. The Collector obtained Government sanction to get up a subscription fund and Rs. 1,600 was raised in this way from the cultivators, while Government contributed Rs. 650 in addition to providing the organization and supervision of the work. Three principal difficulties had to be contended with: (*a*) the fact that many of the cultivators are Jains and object to take life, (*b*) the relationship between landlord and tenant which does not enable a tenant to secure the full reward of his labours, and (*c*) the lack of co-operation on the part of the adjoining Native States. However, a scheme was prepared and work began on the 26th July and lasted till the first week of October. The whole area was divided into 4 blocks of 1,250 acres each and a gang consisting of 40 nets with the necessary men and boys allotted to each. This arrangement worked fairly well but it was only feasible to actually work the nets during the intervals when it was not raining. Moreover, most of the labour was hired and hence the men had not that personal interest in the success of the work which urges the owner on.

Altogether 7½ million hoppers were destroyed and it was estimated that a 10-anna crop had been secured. Taking into consideration the severity of the pest this year as compared with 1909, it is probable that in the absence of these preventive measures about one-third of the area would not have yielded enough to pay the assessment and the rest could not have given a crop of more than six annas. The attitude of the cultivators is on the whole favourable, but owing to caste prejudice most of them refuse to actually participate in the work though they are willing to contribute to the funds.

A still more serious pest judged by the area and value of the crops involved is the Dhárwar grasshopper (Colemania sphenarioides, Bolin) which has steadily been increasing in the Deccan and Southern Marátha Country for some years past. It attacks jowár and bájri. In the Southern Marátha Country the more seriously infected areas are to be found in the Belgaum and Dhárwár districts. Accordingly in the year under report steps were taken to see what preventive measures were possible and it was decided to try the feasibility of netting these hoppers on a block of 800 odd acres in Ránibennur Táluka and see whether it was possible to eradicate the pest from all the jowár fields within that block. This piece of land was favourably situated, being triangular shaped and bounded by a railway, a road and a nállah on the three sides, respectively. The work was commenced about

the 20th of August and lasted a month. The first few days were devoted to finding out the most suitable type of net to use and how to use it. It was found that the drag nets could be most conveniently worked when the plants were some 1 to 3 feet high, *i. e.*, when they were supple and that in the later stages it was necessary to use hand nets and shake the hoppers off the plants into these small nets. Altogether 2,368 lbs. of hoppers, estimated to number 40 odd millions, were destroyed at a cost of Rs. 457-15-0.

In a work of this nature it is obvious that success depends entirely upon cooperation and united effort over large areas, otherwise the hoppers spread back on to a small area which may have been netted and it is soon just as much infected as any other place. In order to demonstrate, if possible, the practicability of keeping a large area free of hoppers by this method it is proposed to control the same area for a year or two more.

Steeping.—Steeping jowár in copper sulphate solution as a preventive of smut gave substantial results at Dhárwár in the year under report. On the unsteeped plot there were 1,580 smutted ear-heads per acre, while there were none on the treated plots. About 150 smutted heads were observed on the plots in which the seed had been steeped in hot water, it was found that 100 smutted ear-heads gave 3 lbs. 6 ozs. of grain and 100 heads of sound ear-heads gave 14 lbs. 3 ozs. of grain or a difference of 10 lbs. 13 ozs. Therefore 1,600 smutted ear-heads means a loss of roughly 170 lbs. of grain per acre worth Rs. 5-8-0 while the cost of the copper sulphate amounted to only half an anna per acre.

Implements.

Ploughs.—For some time past the extremely important question of finding a means whereby the black soil tracts in the Deccan and Southern Marátha Country could be deep ploughed and thoroughly cleaned of the deep-rooted weeds such as Heriali (Cynodon dactylon), Chirdo (Cyperus rotundus), Kunda (Andropogon Punctatus) which are at present almost everywhere in full possession of the land. The direct traction iron plough (the Gallows) does very good work but it does not plough deep enough to remove these weeds at the first attempt; hence it is important to discover a plough which will go 16 or 20 inches deep. Such a depth cannot be satisfactorily attained by direct bullock traction and hence a plough worked by gearing was secured from France. This is a balance plough manufactured by Messrs. Bajac and Co., of Lyons, and is hauled by means of wire cables alternately from one end of the field to the other by means of windlasses set on wheels which run on steel rail tracts; these windlasses are each worked by one pair of bullocks or buffaloes. The cable length is about 240 yards. This plough does excellent work penetrating fully 16 inches which could probably be increased to another two inches while the width of the furrow is also about the same dimension. It is natural that a plough worked in this way should travel slow and slowness seems to be the only serious defect of this implement. About one-fourth of an acre can be ploughed in the course of a working day of 8 to 9 hours. One man is required to set the plough and steer it while a pair of bullocks and a driver is required at each gear; in practice the cattle get about half an hour's rest between turns and hence it is sometimes more convenient to use only one pair of cattle for both winlasses by taking them first to one and then to the other but by this arrangement less work is done. Apart from steam ploughing this plough seems to be one of the most promising solutions of the problem. It has been carefully estimated that the cost of turning up this land per acre by different methods amounts to—

Rs.	a.	p.	
40	0	0	Digging by hand (the common practice of the people).
22	0	0	French plough.
17	10	0	Steam plough.

The latter figures allow for interest and depreciation on plant.

The cost of the several parts of this French plough are as follows—

	Rs.	a.	p.
One Balance plough	596	0	0
Two Gearings with all accessories	1,875	0	0
Two small jack screws	62	0	0
Painting, packing, etc.	238	0	0
Freight to Bombay from France	329	0	0
Total ...	3,100	0	0

It is thought that the working of this implement can be made still more economical by using a two gang plough but this point has still to be settled.

Another important point to note is that the same tackle is suitable for hauling any of the usual farm implements such as cultivators' harrows and the like and that such work can conveniently be done by the indirect method where direct bullock traction is out of the question owing to the difficulty bullocks find in walking over very rough ploughed

land. It is proposed to purchase a set of these implements. Large cultivators have already shown their appreciation this implement and arrangements have been made to hire it out for a monthly charge of Rs. 100 including a man in charge on say Rs. 12 or 15.

Mowing machine.—There are large areas of grass land in Gujarát on which the grass is annually cut and made into hay. These grass areas are in the hands of well-to-do men who, in addition to any area they may themselves own, purchase other extensive areas at the yearly auction sales held by Government. It is, however, becoming increasingly difficult to get the grass cut in good time owing to the tendency for labour to get scarcer and dearer every year and it is not out of the way for one of these grass land-owners to advance as much as Rs. 2,000 to safeguard the supply of labour and even then he is sometimes disappointed. On the other hand there are several natural difficulties which at once present themselves when the suggestion to utilize machinery is made. The black soil areas have the peculiar characteristic of forming huge cracks which in a short time develop into large depressions and holes sufficiently large to take in a man. Another characteristic feature, in the grass areas on black soils in particular, is the babul with numerous sturdy seedlings coming up all over the field. In spite of these difficulties it was decided to experiment with a mowing machine and after consultation which Mr. Milligan of the Punjab Agricultural Department a "Thistle" machine manufactured by Messrs. John Wallace and Co., of Glasgow, was purchased.

This is a substantially built machine costing £13 in Glasgow and another £2 to land in this country. Trials at Surat showed that with care this machine could be worked successfully over very rough ground and it was lent to a man in Khudvel village in Chikhli táluka of the Surat District who cut a large area of grass and found that a good average pair of cattle could conveniently work it and that cutting "all round" he could finish an area of 4 acres in a working day of 8 hours. There are now several inquiries about mowing machines and some of the more enterprizing men have taken steps to get babul seedlings dug out and the larger holes filled up in the fair season so as to make the conditions favourable for uninterrupted work.

A native firm, Messrs. R. M. Vasi and Co., Bombay, are arranging to take up the agency for these machines and intend to keep a couple for sale on the Surat Farm.

Well Boring.

Five sets of Cawnpore Boring apparatus were employed throughout the year and one additional set was borrowed in January from the Executive Engineer, Surat, for use in the Surat District. Four sets were kept in the Kaira District chiefly in the Borsad táluka, one set was kept in Ahmedabad and one in the Surat and Broach Districts. Owing to the success met with by this Department, Baroda State has now ordered a set, as have also the Local Boards of Kaira and Broach Districts and accordingly Overseers have been sent to this Department for training in the work. Altogether 49 wells were bored between 1st July 1910 and the 30th April 1911, of which 38 proved successful, 5 partially successful and only 6 unsuccessful and hence the percentage of successes is as high as 88 per cent. as against 56 per cent. last year. This is chiefly due to us having located a favourable tract in the Borsad táluka of the Kaira District. Out of 35 wells bored in this district 26 were successful, 5 partially successful and only 4 unsuccessful. In Ahmedabad District 6 wells were bored and all proved successful, as did 4 borings in the Baroda State territory. In Surat District 3 wells were bored but only one is really successful because in the other two although a good supply of water was tapped it proved to be brackish. In Broach District the only well bored proved successful. The average cost of coolie labour for boring works out at Rs. 1-0-6 per foot as against Rs. 0-13-4 last year but this is chiefly due to the boring of 4 wells under difficult circumstances, and if we exclude these the rate works out at Re. 0-12-11 per foot. The depth bored has averaged about 60 feet but one boring at Icchápur in the Surat District amounted to 131 feet when an excellent supply of water was tapped but it proved brackish. The largest volume of water was tapped in the Rangipura and Khánpur villages of Borsad táluka where 5 and 6 koses were added to the existing supply at depths beyond 70 feet below the bottom of the wells which were 50 to 60 feet deep. The total current expenditure during the year ending 31st March 1911 amounted to to Rs. 4,266-8-8. The recoveries for the year ending 31st March 1911 amounted to Rs. 2,500-4-4 for the cost of piping and wages of Mukadams in the case of successful wells and hence the net cost to Government for working expenses including establishment charges amounted to Rs. 1,766-4-4 for the year ending 31st March 1911. In addition to this the following expenditure was incurred:—

	Rs.	a.	p.
Additional plant	1,819	5	4
Piping	3,252	9	6

of which the latter item is recoverable as it becomes used up in the wells.*

On the 31st March 1911 the value of the plants on hand amounted to Rs. 7,129-7-8 inclusive of Rs. 1,801-8 the estimated value of the old jumping tools.

*Already partly recovered in the amount of Rs. 2,500-4-4 shown above.

Introduction of improvement to the notice of cultivators.

During the course of the year 5 shows and 19 demonstrations have been organized. The latter are held annually one on each farm and in connection with the large fairs which form a feature of the country life in this Presidency and which attract enormous number of cultivators. For this reason it is probable that the Department gets better value for its money by organizing these demonstrations than by holding expensive shows. In addition to these larger demonstrations numerous small ones with special reference to one particular thing have been conducted of which the gul-making demonstrations in the S. M. Country and Kánara are typical. In this economy of fuel is one of the chief points and this was appreciated by an old gul-boiler at Upponi when he exclaimed "with the quantity of megasse and dry leaves burnt by you, even the bottom of the pan would not have been heated".

In order to popularize artificial manures on irrigated and garden crops the Divisional Inspectors organized demonstration plots at a few places with considerable success. Large quantities of seed of improved or new crops such as cotton and groundnut have been distributed and in the neighbourhood of Surat alone 3,000 acres of cotton were sown with seed of improved cotton evolved on the Government Farm.

APPENDIX D.

Summary of work done under the Deputy Director of Agriculture in Sind in 1910-11.

The season 1910-11 has on the whole been good and all round; agricultural conditions are satsifactory. The leading feature in Lower Sind was the high price of cotton which obtained as much as Rs. 12 per maund of 'kapas' as against Rs. 5—6 which it used to fetch some years ago. Some damage was reported from frost in December but the total estimated outturn of 150,000 bales was probably the largest yield yet obtained in Sind. It is nearly all produced in Hyderabad and part of Thar and Párkar and there is a firm idea that it will not grow in North Sind. The results obtained on the farm and sub-stations do not confirm this idea and cotton cultivation is gradually creeping north. The results from sub-stations seem to point out that cotton will grow wherever jowár is suitable. This will result in a very large area of cotton being cultivated where at present it is unknown.

In order that these and similar facts may be properly elucidated central experiment farms will soon be established in the chief representative tracts, each having a number of sub-stations and demonstration plots in touch.

The central farms are Mirpurkhás and Sukkur, and Lárkána Farm will be started during the present year. There is also a farm at Doulatpur for the purpose of reclaiming salt or alkali land which is an important problem in Sind. The sub-stations during the year under report were:—

Badin. Tando Mahomed Khán Talhar	in South Sind.
Naushahro Feroz Nawab Shah Hála	in Mid Sind.
Jacobabad Shikárpur Ubauro	in Upper Sind.

Farms.

Mirpurkhás.—A separate report is issued for this farm dealing with the work in detail It is the head-quarters of the department and the chief lines of work are in cotton and rotations. Most of the seed is distributed from here. A workshop for making implements is situated here and fruit culture and poultry breeding are being carried out.

Sukkur is newly established. It was a very rough piece of ground and much levelling was required. As the ground was salt in addition, it took some time to get into proper condition. It is irrigated from the Indus by a centrifugal pump and portable steam engine. Comparative experiments are not so much required as the demonstration of suitability of various common crops for Sukkur and Upper Sind Frontier. Ordinary cultivation is remarkably poor in the number of crops cultivated. The situation of the farm is good and in a few years it will probably exercise a considerable influence in the district.

Lárkána.—The land for the farm has been selected within a short distance of Lárkána town and station. It is situated in the heart of the best agricultural district in Sind. A considerable part of the farm will be devoted to rice cultivation which is the staple crop of the district. Cotton, cereals and rotations will also be included; a garden will be established.

Daulatpur.—The reclamation work on this farm is now practically finished and it is hoped that this year the produce of the cotton will pay off all expenses leaving the increased value of the land as profit on the undertaking. The work has proved that the Egyptian methods of reclamation are very suitable for Sind and can be profitably adopted on a practical scale. When finished the farm can either be sold or it would form a useful area (400 acres) for a seed farm for the production of American cotton seed, berseem seed or the breeding of young stock.

Sub-stations.

Most of the sub-stations consisted of four or six 1-acre plots and a 1-acre plot divided into $\frac{1}{40}$ths of an acre. In some cases the land was on hire and in others on loan from zemindars. Badin and Ubauro were failures owing to water-supply and Jacobabad and Naushahro were poor for various reasons. The others were quite good and during the season were attended by a number of local zemindars. Similar plots are being continued this year. Each group of sub-stations is in charge of a graduate who keeps a house rented

at his head-quarters as a seed store and office. When there is no work on his sub-stations the graduate tours round his district and holds demonstrations with implements and shows seeds, etc.

CROPS.

Cotton.

The cottons cultivated on the various farms are Egyptian (Mit-Afifi and Abassi), Upland American and local Sindhi.

Egyptian cotton.—This was sown only at Mirpurkhás. There was none cultivated on the Jamrao Canal as it was decided that its cultivation should not be pushed till 1912 when certain repairs would be completed on the canal.

American Upland.—Boyd Prolific and Texas Big Boll were cultivated in all districts except Karáchi in small quantities. Yields were satisfactory except where sown on unsuitable ground. It is not suited for 'Kalarish' ground or sandy soil. On the farms the yield varied about 5—6 maunds per acre, the highest yield in the sub-stations was 602 lbs. of Triumph at Nawabshah. Zemindars report 4—10 maunds per acre and the Wazir of Khairpur yields of 2—13 maunds per acre. In most cases the growers mixed and sold the produce as Sindhi cotton.

The valuation of the different varieties under trial is as follows:—

No.	Variety.	Percentage of lint.		Classification, 1911.	Value.	
		1910.	1911.		1910.	1911.
1	Texas Big Boll ...	31·25	30·07	Clean; dull; staple rather rough, short and mixed.	8·60*d.* @ 8·70*d*	Worth about 25 points on Middling American Futures.
2	Boyd's Prolific ...	31·23	31·6	Clean; fair colour; staple short but free from waste.	8·40*d.*	Worth about price of Futures to 20 points off.
3	Triumph ...	35·71	33·5	Clean; good colour; very mixed in staple and consequently very difficult to value.	8·60*d* @ 8·70*d.*	If staple equal to best and regular would be worth about 50 points on.
4	Black Rattler ...	33·37	29·9	Clean; good colour and very good staple.	9·25*d.*	Worth about 100 points on Middling Futures.
5	Tooles ...	33·33	34·3	Very clean; staple rather short but hard and free from waste. Useful cotton.	8·60*d.*	Worth about 20 points on.
6	Peterkin ...	33·30	34·3	Clean; good colour; staple short but very hard and rather rough. Useful cotton.	8·50*d.*	Do.
7	Allen's Improved Long Staple.	30·56	27·50	Clean; good colour; staple very long and strong.	10½*d.* @ 11 *d.*	Worth today nominally about 200 points on.
8	Griffin ...	30·0	29·6	Excellent style and staple very free from waste; very clean and good colour. Very useful cotton.	11·00*d* @ 1·50*d.*	Worth about 60 points on.
9	Dhárwár-American (Indian cotton).	...	26·1	Very poor; style clean but very dull and green spotted; staple very short and tender. Would probably be mixed with short Surats staple.	.....	Might be worth about 100 to 150 points off but value extremely doubtful.

"You will observe that 'Allen's Improved', 'Black Rattler' and 'Triumph' are reported upon as being the most suitable cottons; but all the others with the exception of 'Boyd's Prolific' and 'Dhárwár-American' varieties are 'useful Cottons', and would find a ready demand in this country.

(Signed) W. H. HIMBUDY,
British Cotton Growing Association.

Note.—In 1910 value of Middling American = 8·20 *d.*

As it has been found impossible to get a market price for any of the long stapled cottons from any of the local firms it is possible that the British Cotton Growing Association will start a buying agency in Sind.

Sindhi Cotton.—In Sindh cotton it has been found that the cotton grown round Hálla is superior in staple and ginning percentage to that in other parts of Sind. So this seed is being used on all farms. A ginning agency in Mirpurkhás is also distributing this seed extensively for sowing on the Jámráo area. At Mirpurkhás one 1-acre plot gave 1,304 lbs. On the sub-stations the best yield was 822 lbs. at Hálla.

Hot Weather Cereals.—The jowárs under trial were Chapti, Sholápuri and Perio from the Presidency, local jowár and Upper Sind, Red and Green jowárs. The three Presidency jowárs have very much better seed than any of the local jowárs and give a larger outturn but they take a longer time to mature and consequently are only suitable for certain tracts.

Among the bájries tried the local variety seems as good as any. The Nigerian variety, which has very long ear-heads, has deteriorated considerably and new seed has been ordered from the West Coast of Africa.

Maize is a minor crop in Sind and generally grown for the green cobs. There is little sale for the grain.

For fodder it has been found that the local jowár or red jowár from Upper Sind giver as good a yield of green fodder as either Nilva or Sundhia which are Presidency foddes jowárs.

Wheats.—Selection from local varieties has been going on for some time in order to get pure seed of suitable red and white wheats for distribution. The ordinary wheat field of Sind shows generally a mixture of red, white, bearded and beardless varieties with a percentage of barley; so pure seed of any variety is necessary.

At Mirpurkhás a manuring experiment has shown up each year the great necessity of thorough cultivation during the hot weather. Best results are obtained by ploughing immediately the wheat is cut and thereafter ploughing after each fall of rain.

A number of South African, Australian and Indian wheat varieties are under trial.

Berseem (Trifolium Alexandrium).—This was sown at Mirpurkhás, Daulatpur and Sukkur. Owing however to the closure of the Jámráo canal for two months it was not considered advisable to distribute it on a large scale. From this season too only a little seed has been obtained in the current year. It is likely to spread quickly in the Jámráo area and wherever cold weather water can be obtained. As a rotation fodder crop it is probably unequalled for yield and quality. It readily sells at Rs. 12—15 per acre per cutting. When cattle are tethered on it the land is doubly enriched.

Miscellaneous.—The common oil seeds and fibre crops were cultivated and among pulses those in general use in the Presidency. At Mirpurkhás an attempt was made to compare the value for green fodder of the common pulses.

		Results were
These were cut and fed to cattle green	Guvár	... Good fodder, second growth poor.
	Chola	... Good fodder, second growth little.
	Vál	... Growth best of all and repeatedly cut till killed by frost in December.
	Mathki	... Good growth, but after cutting poor.
	Mung	... Moderate, no second cutting.
	Kulthi	... Growth good but no stock would eat it.
	Udid	... Growth good but no second cutting.

These were sown in June and part of each plot cut and fed in August. These test will be continued but Vál and Choula are the most useful so far.

Tur or pigeon-pea was sown on all farms and subs-tations; in all cases it gave good yields. It will probably extend in Sind.

Sugar-cane was cultivated at Mirpurkhás and is sold for eating. It is the Pundhia variety from Poona and is of a superior quality to any Sindhi or Punjab canes in Sind. Cane cultivation will probably extend in the Jámráo area though there is not much market for 'gur', the establishment of small sugar factories will be necessary; one of these is already working, having been erected by a zemindár.

Other minor crops chiefly grown at Mirpurkhás are mentioned in the report of that station.

Irrigation Experiments.

The following statements of irrigation results are attached herewith :—

1. Results of Kharif crops, Mirpurkhás Farm.
2. Rice Experiments on Sukkur Farm.
3. Wheat on Mirpurkhás Farm.

Statement showing the results of Irrigation Experiments carried on the Mirpurkhas Farm, 1910.

No. of Plot.	Crop.	Previous cropping and cultivation.	No. of watering.	Date of sowing.	Date of last watering.	Total Canal watering in cubic feet per acre.	Total Canal watering in inches.	Total rainfall in inches.	Produce in lbs. per acre.	Remarks.
1	2	3	4	5	6	7	8	9	10	11
C. 4	Egyptian Cotton Abassi.	Berseem in Rabi, 1909. Twice ploughed, sammared and ridged. Seed dibbled on ridges.	15	15th April 1910.	24th October 1910.	114,207	31½	7·88	254 Seed Cotton ...	This crop is sown on ridges and the 1st waterings are given along the bottom of the farrows. No berseem sown in Rabi.
C. 5	Sindhi Cotton ...	Berseem in Rabi, 1909. Ploughed four times, and seed sown after the last plough and sammared.	7	19th May 1910.	23rd October 1910.	72,389	20	7·88	1,304 do. ...	No Berseem sown in Rabi.
C. 6	American Cotton Boyd Prolific.	Berseem in Rabi, 1909. Twice ploughed and seed sown after the plough and sammared.	12	24th May 1910.	6th December 1910.	129,988	35	7·88	330 do. ...	Berseem sown broad casted on 25th September 1910. Four last waterings for berseem.
C. 7	Egyptian Cotton Mit Affi.	Berseem in Rabi, 1909. Twice ploughed and sammared and ridged. Seed dibbled on ridges.	20	15th April 1910.	7th December 1910.	168,514	46¼	7·88	342 do. ...	Berseem sown. Four last waterings for berseem.
D. 6	Sholápuri Jowar ...	Berseem in Rabi, 1909. Twice ploughed and seed broad casted and then sammared.	9	27th May 1910.	15th November 1910.	98,336	27	7·88	960 lbs. Grain and 7,500 lbs. Fodder.	This crop is much later in ripening than local Rabi jowar.
D. 7	Awned Bajri ...	Berseem in Rabi, 1909. Twice ploughed and seed broad casted.	6	18th May 1910.	28th September 1910.	61,960	17	4·88	60 lbs. Grain and 1,000 lbs. Fodder.	This crop was a failure owing to insufficient watering.

NOTE.—A preliminary watering of 15,000 cubic feet per acre given to each plot to soften ground for cultural operations.

Rice Experiments on Sukkur Farm, 1910.

Crop.	No. of watering.	Date of sowing in seed bed.	Date of transplanting.	Total cubic feet of water.	Yield in lbs. per acre.	Remarks.
1	2	3	4	5	6	7
Rice ..	35	28th May 1910.	30th June 1910.	562,987·62	1,092	The land has been newly levelled. It is very salt and this is the first crop which has been cultivated on it. It was originally covered with little mounds of Kalar dust in which "dubb" grass was growing. Land was levelled and bunded. Each plot consists of one acre surrounded by a drain and divided into two by a small bund. The plots were watered from "pucca" channels which received water from the pump on the Indus. It was found necessary to run the water off occasionally. When the plots were allowed to dry up, plants immediately suffered and it was found necessary to keep the water standing all the time. New water was supplied as soon as rice showed signs of drying. The seed was sown in a roughly prepared seed bed. One pound of rice seed was sown on a piece of land measuring one "guntha." This gave sufficient seedlings for an acre. The Rice Crop was harvested on the 25th October 1910.
Do. ..	34	Do. ...	Do. ...	647,378·31	928	

Irrigation Results, Mirpurkhas Farm, 1910-11.

Variety of wheat.	Date of sowing.	Number of waterings.			Total.	Remarks.
		1st.	2nd.	3rd.		
Sindhi white ...	3rd November 1910.	1st January 1911.	21st January 1911.	24th February 1911.	3	An estimated 3" watering was received by each plot at each time. Produce was from 7 to 8 maunds of dressed wheat per acre. Yield would have increased by another watering but water supply was deficient.
Do. ...	2nd November 1910.	Do. ...	22nd January 1911.	Do. ...	3	
Do. ...	9th November 1910.	Do. ...	Do. ...	25th February 1911.	3	
Do. ...	10th November 1910.	2nd January 1911.	21st January 1911.	Do. ...	3	
Do. ...	12th November 1910.	Do. ...	23rd January 1911.	26th February 1911.	3	
Do. ...	13th November 1910.	3rd January 1911.	22nd January 1911.	27th February 1911.	3	

Fungoid and Insect Pests.

During the year the chief complaints have been about "Mahlo" or mango hoppers, rust and smut in wheat, stem borer in jowár, and from round Karáchi the potato moth.

The "Mahlo" has been exceedingly destructive and in many gardens not a single mango can be found. The Imperial Entomologist recommends spraying with crude oil emulsion before the trees flower and all old weak trees to be cleared out. For the potato moth the seed potato should be steeped in crude oil emulsion. A leaflet is being prepared about these two latter.

The others are perennial and probably not much worse than usual.

Garden and Fruit.

Fruit and vegetables have been grown at Mirpurkhas for 2 years and a small garden has been begun at Sukkur. In the cold weather the common English vegetables all do well and in the hot weather cucumbers and water melons. Also it has been found possible to carry some vegetables, such as tomato, beet, sprouts and cabbages through most of the hot weather.

Of the fruit trees peaches obtained from Saharanpur are the most thriving and have produced a good crop of fruit this year. Grapes have also done very well. There is a local purple grape, a very heavy bearer and rank grower, which can be made to bear from June till November.

There is a considerable demand for grafts and cuttings from local zemindars, especially for oranges, etc. Land has been provisionally selected for growing vegetables especially potatoes, and fruit trees at Landhi near Karachi. This is the centre of a market garden industry whose market is in Karachi.

Poultry.

A beginning has been made with poultry. As the climatic conditions are so severe English fowls were not obtained, but 2 breeds are being kept at Mirpurkhas—Aseel or game from Upper Sind and Busrah from the Gulf. The first are excellent table birds and the latter very good layers. Both are very hardy and the hatchings from both breeds gave good results last cold weather. A few turkeys have also been reared. There is a local demand for good young pullets and cockerels.

Seeds and Implements.

During the year a considerable amount of seed of various kinds was distributed, especially of cotton and cereals, both from the farms and local seed stores and sub-stations, and in some cases direct from growers.

Implements are being made at Mirpurkhas and Sukkur. These are the plough, leveller and Norag or threshing machine. 700 ploughs have been made in the current year, and as it is not possible to supply the demand, arrangements are being made with a Karáchi firm to make the ploughs in quantity.

Demonstrations and Shows.

Periodical demonstrations were held on all the farms and sub-stations and also by members of the staff in the districts as also by itinerant graduates in all parts of Sind. They have been attended by a large number of zemindars. A show was held at Shikárpur and one at Talhar and a smaller one at Tatta. Besides the departmental exhibits of seeds and products and implements classes were arranged in conjunction with the local boards for district produce.

Publications.

A series of leaflets on new crops and implements were published in English and Sindhi and widely distributed. Numerous reports on agricultural subjects were prepared during the year for the information of Government and some for publication in the Agricultural Journal.

School.

In order to train up young men for the Department and also for the sake of giving some insight into modern methods of Agriculture to zemindars' sons a vernacular agricultural school will be opened at Mirpurkhas in the present year. It will begin with a small number of pupils at first and can be extended in the event of success. The course will be an 18 months one and will be made as practical as possible and is intended for zemindars' sons of 18—20 years of age.

G. S. HENDERSON,
Deputy Director of Agriculture.

APPENDIX E.

SUMMARY OF WORK UNDER THE PROFESSOR OF AGRICULTURE. 1910-11.

The Professor of Agriculture besides being in charge of the teaching of the subject of Agriculture, as outlined in the Syllabus of the Agricultural College, acts as Deputy Director for a circle composed of five collectorates Násik, Poona, Sátára, Ahmednagar and Sholápur. This report deals of work performed in the latter capacity.

I.—EXPERIMENTAL WORK BY CROPS.

Sugarcane.

1.—Rotation Experiments.

The permanent series has been continued and one cycle completed but no effects of rotation were possible the first year. The cycle extends over four years and includes two years of cane followed by gram. The fourth year only is the rotation differentiated when fodder jowar is taken. San is grown for green manure and the plot is fallowed in preparation for the cane. So far the results show no considerable effects from the two latter treatment, while when fodder is taken the feed obtained is worth 80 to 100 Rupees per acre. The lack of results from these treatments may be due to the usual heavy manurial treatment which supplies all the requirements of the cane. It is proposed to change the scheme of the experiments in the next cycle slightly by reducing the quantity of manure applied to the fallow and san green manured plots.

2.—Manure Experimemts.

(*a*) *Trials of mineral manures.*—No new manures of this class were tried. Sulphate of ammonia used as the sole top dressing after farmyard manure supplying 200 lbs. of nitrogen (about 40 cart-loads) at the rate of 750 lbs. per acre (supplying 150 lbs. nitrogen) gave as good a crop as the cake plot applied on the same nitrogen basis at approximately the same cost, so that sulphate of ammonia may safely be used to replace safflower cake on basis of nitrogen, or using 3 lbs. of the mineral instead of 10 lbs. of cake; and price should govern its use.

An even more economical use of the mineral is to give a combined application of sulphate of ammonia 3 cwts. per acre and 2½ khandis (1,200 lbs.) of the cake.

This combination at Mánjri increased the yield over safflower cake above by nearly 10 per cent.

The same dressing at Karanja in the Nira Valley yielded also better returns than the usual application of castor cake at a cost of Rs. 50 less per acre.

The same combination has been tried with equally good success on the well irrigated cane of Wálva, táluka Sátára, but the quantities used were only about two-thirds the quantity used on canal irrigated tracts.

At Sholápur the sulphate of ammonia was equal in yield to the plot dressed with cake alone.

(*b*) *The experiments to determine the best combinations of farmyard manure and safflower cake*:—These were continued at Mánjri. The yields of these plots were reduced by the frost which came in February. But if the reduced outturn can be relied upon, it goes to confirm last year's results, *viz.*, that the dressings of both farmyard manure and the top dressing can be considerably reduced without affecting the yield.

(*c*) *Different times of applying top dressing.*—Here again last year's results are confirmed and no increase in outturn is noticed from applying top dressings in good retentive soils carefully watered. All the manure is best applied before planting.

(*d*) *Potash and Phosphoric acid experiments.*—In these plots the usual dressing of farmyard manure 40 loads and 1,200 lbs. of safflower cake is supplemented by application of sulphate of potash or superphosphate or both as the case may be. The results of previous years as to the value of potash are clearly confirmed, but as regards the phosphoric acid the result is negative. These plots suffered less from frost and the yield was fair, so that the results are of some importance. I think it can be safely said that the application of about 300 lbs. of sulphate of potash will increase the yield fully 10 per cent., which means a gain of from 75 to 100 Rs. per acre. The matter is now ready for bringing to the notice of cane-growers as the result of four years' experience. As to superphosphate more experimental work is necessary.

(*e*) *The quality of gul.*—This work with regard to manure was not taken up this year.

(1) *District Experiments.*—It has been demonstrated clearly at Karanja in the Nira Valley that a lighter dressing of manure is more profitable. See statement below :—

Name of station.	Dressing containing 450 lbs. N.		Dressing containing 350 lbs. N.	
	Outturn of gul in lbs.	Profit.	Outturn of gul in lbs.	Profit.
	Lbs.	Rs. a. p.	Lbs.	Rs. a. p.
Káranja (Nira Valley) ...	11,824	458 6 1	11,784	397 12 1

At Sholápur the experiments did not prove that the lesser quantity was as profitable.

(2) At Bárámati there is a prejudice against the use of safflower cake, but it has given practically the same outturn.

(3) The use of cakes in Sátára during the past year has proved very valuable, increasing the yield by about 1,000 lbs. of gul per acre. This work has been continued in Sátára and begun in the sugar tracts of Násik and Nagar this year.

3.—Irrigation Experiments.

The irrigation experiments of the year were carried on at Bárámati and at Sholápur. The results in both places show that about 390 thousand cubic feet of water will give the best outturn of cane. This is equal to a rainfall of 80 inches.

Increase of application in all cases reduced the outturn as did a smaller application. The best interval of days for watering was 8 in hot weather and 10 in cold.

This is in agreement with the previous experience, and it may be considered as practically settled that this is the best amount of water for cane.

The power crushing continues to give satisfaction ; the cost of crushing with power and gul making comes to Rs. 1-0-0 per boiling, while the local rate by contract was Re. 1-8-0. The average extraction was 70 per cent. by the Manjri crusher.

The plant at Káranja worked successfully, and I learn that the average per cent. of extraction was about 70 per cent. and the cost of making gul by this plant was about Re. 0-12-2.

Crushing tests were made at Mánjri of several bullock mills including the modern mills of Násik and Sátára, the Poona iron mill, the Behar mill, the Nahan mill and the Pearl (an American pattern). The capacity of the first two mills is much less than that of the others as the cane has to be passed three times through the mills, they being of the two-roller type ; but the draft is however less. The extraction per cent. is considerably below that of the iron mills. The Poona iron mill is a 3-roller mill, but the half crushed megass has to be returned by hand.

The Behar mill is a small mill of only about two-third the capacity of the Poona mill. It gave about 5 per cent. less extraction.

The Nahan mill is of slightly less capacity than the Poona mill and gave a little higher extraction. The cane passes through second pair of rollers automatically.

The draft of the Nahan is the same as that of the Poona local.

The Pearl mill is of the horizontal type. Its capacity is one-third greater than the Poona local and the draft is fully ¼ less, but the price is 2½ times that of the Poona local. The Pearl mill also feeds the second crusher automatically. It is very simple to adjust and the adjustment could be locked so that labourers could not loosen it to ease the strain on the bullocks ; but when both the Poona and the Pearl are carefully adjusted there is little to choose in efficiency.

The Poona mill dealing with the same cane as these mills extracts another 4 per cent. of juice.

4.—Boiling of gul (crude sugar).

Work under this head consists of trial of new patterns of furnace at Mánjri and the demonstrations of the Poona furnace and the system of gul preparation in Sátára, Násik and elsewhere.

The work under the first head was not completed, but an adaptation of the United Province furnace, by Mr. P. C. Patil, which utilises the waste heat to warm the juice before it goes into the boiling pan proper, by which process both increased daily capacity and the saving of the fuel is effected, was tried with very promising results. Other patterns tried did not give any results.

The Poona type of furnace differs from those in general use elsewhere in the circle by having a draft fuel and ashpit by which means a more perfect combustion is effected,

resulting in a great saving of fuel amounting to from Rs. 50 to 75 per acre of cane and in a saving of considerable time.

The pans in general use with the types of furnace outside Poona are very deep and the skimming is imperfectly done as a result of which the gul is dark in colour and of much poorer quality.

The demonstration of these advantages was carried on at 3 centres of Násik and 8 in Sátára district by trained men supplied from Mánjri farm working under the directions of the Divisional Inspector of Agriculture, C. D. This is the third year of the work at Sátára and it is beginning to take effect, many cultivators of cane having adopted this process. Experienced gul makers have been sent to several other parts as Dhárwár, Belgaum, Goa, Kolhápur State and Sind.

Groundnuts.

Experiments with this crop fall under five heads—1. Manurial; 2. Spacing; 3. Varietal; 4. Mixtures; 5. Distribution.

1.—Manurial.

These were carried on on Mánjri farm and at Islámpur, Shirala and Sholápur.

The results at the various centres show that under different conditions different manures are required. Sholápur soils were highly benefited by lime as indeed were all the experiments, but the quantity used (1 ton) increased the cost too much. One-fourth of a ton would no doubt pay better everywhere. Nitre gives no promise of paying as a groundnut manure. Sulphate of potash used at the rate of 2 cwts. per acre may be depended upon to give 25 per cent. profit on the investment.

2.—Spacing.

These experiments were carried on at College farm.

The general result is that when heavily manured and irrigated, thin sowing is most profitable, that is one foot by 9 inches for the larger forms, 9 inches by 6 inches for Pondichery and Country, and 6 inches by 4 inches for the small kind.

But in the case of poorer soils without irrigation, the thinner spacing has in most cases given better results, that is 1 foot by 1 foot for the large variety, one foot by nine inches for the medium, and 9 inches by six inches for the small variety.

3.—Varietal tests.

These were made at College and Mánjri farms.

Two new varieties were tried, Egyptian and Mauritius. The latter is a 8-seeded pod and slightly resembles the indigenous in form and taste. It is a good yielder, ranking with Virginia and Large Japan. Egyptian is very similar to Pondichery, but a slightly better yielder. The Big Japan and Virginia are of nearly the same character and yield—about four thousand lbs.—under liberal treatment. The Pondichery is smaller and yields about 10 per cent. less, while the Small Japan and Spanish Peanuts, which are distinct varieties though of similar habits and growth, yield only about 2/3 that of large variety, but they require less rich soil and less water.

4.—Mixtures.

The trial of groundnut and cotton and groundnut and jowár as mixtures has not proved a paying mixture. The effect upon the succeeding crop of jowar was tried and marked beneficial results were obtained, especially with the exotic variety.

5.—Distribution.

This year 18,709 lbs. of exotic groundnuts were distributed in the following tálukas:—

Sholápur District.

Bársi, Sangola, Pandharpur and Sholápur.

Ahmednagar District.

Akola, Nagar, Párner, and Shrigonda.

Násik District.

Yeola, Násik, Sinner, and Násik.

Poona District.

Haveli (Loni), Bárámati.

Sátára District.

The valuable properties of requiring less water yielding heavier outturns and of quicker growth have convinced the people, where they have been distributed, of their great use, and they are extending from each centre of distribution.

Bájri.

Work with the Awned Bájri at Mánjri has been continued, but it still persists in throwing Awnless heads although it is carefully isolated from other Bájri crops.

On the College Farm, it was grown in a test with seed from other parts. The Awned was better than the local one but not equal to the Akola or Nadiád.

Akola Bájri was distributed to neighbouring cultivators and they all speak very high indeed of it.

Jowárs.

Khariph Jowárs were again grown on Nira and their adaptability to the conditions there thoroughly proved, but unless taken up over a considerable area at one time the loss from birds makes their cultivation prohibitive.

Chapti variety from Sholápur is the best.

Rabi jowár is the crop selected for the soil moisture conservation experiments at Nagar and Akalkot. The former suffered severely from frost. In both cases the value of thorough ploughing the land for jowárs is proved. Another proved result is that thinner sowing will almost invariably result in increased outturn of gram with no considerable effect upon the fodder. Sowing one half the usual seed rate at a distance between the rows of 18 inches is certainly to produce a more paying crop than the 9 inches drill. Careful interculture of this crop has largely increased the yield on College Farm.

Steeping with copper sulphate was again perfectly successful on College Farm.

Jowár at Ráhuri under inundation was a failure due to frost, but the yield of kadba 1,400 lbs. from the inundation plots was considerably higher than elsewhere.

Rice.

The ráb work on any considerable scale was brought to a close this year, and the results will soon be written up as a bulletin. The results of the year are in confirmation of previous years, namely, that both heat and ashes play important part in the beneficial effects of ráb. As to substitutes, one may say with confidence that one cart-load of well-rotted farm yard manure, 300 lbs. of poudrette, 25 lbs. of fish, or 50 lbs. of oil cake per guntha of seed-bed may be relied upon to produce better seedlings than the usual branches ráb, at a considerably less cost if the ráb work has to be done by paid servants. Complete mineral manure and superphospate alone have also given better seedlings than ráb, but at a slightly higher cost. If the two classes were combined there is no doubt but better results would be obtained.

Wheat.

The wheat at Mánjri suffered severely from rust. It is very doubtful how far it pays to grow wheat in this tract. Although, notwithstanding the rust, the average yield comes to 1,300 lbs. worth Rs. 65.

Sia Das, a hard white of the Kalakusal type wheat, gave the largest outturn of 1,660 lbs This variety is well worth introducing in the irrigated tract and steps will be taken the coming season to induce cultivators to try it.

Safed of Amritsar has also yielded well but the quality is poor. The Gokák method of planting on ridges did not this year, as it had in previous years, yield any increase over the local method; this is no doubt due to the fact that owing to good rains little irrigation was required.

Inundated plots of Kanhur-pathar wheat gave nearly 1,700 lbs. This is the best dry crop variety in this region, and it is found best in Párner of Ahmednagar.

The growing of wheat after having thoroughly soaked the soil with water in October and then giving no further irrigation has been proved quite feasable.

The wheat raised by inundation by bunding streams at Ráhuri gave 754 lbs., which is high for dry cultivation.

Gram.

This crop occupies a place in rotation of our cultural experiments on College Farm and dry farming experiments at Nagar, and sugar cane cultivation at Mánjri. The principal lesson to be learned from the work with this crop at College Farm is that if the rainfall is good additional irrigation is harmful. Manuring the crop with five loads of manure

increased the outurn some 350 lbs. of gram and an equal amount of Bhusa. The yield from the best manured plot was 2,230 lbs., which is considerably higher than usual yield of this crop even under irrigation.

At Mánjri the average yield was 1,475 lbs.

At Nagar there was an increased yield of 10 per cent. due to the deep ploughing. This was very noticeable in the appearance of the crop and would have been more marked in the outturn if the frost had not reduced all the crop.

Chillis.

A manurial experiment with chillis was laid out on the usual system employed by the Potash Syndicate to demonstrate the value of mineral manures. The results show that minerals as a sole dressing are not so profitable as farm yard manure alone; but a combination of 2½ tons manure with an application of above 2 cwts. each of sulphate of ammonia, sulphate of potash, and superphosphate produced a larger yield and a greater profit. The necessity for application before planting was also demonstrated.

On the students' plots irrigation experiments showed 1 inch of water every 8 days gave better results than more at a time at greater intervals.

Lucerne.

The ridge system of cultivating this crop was on trial, both at Mánjri and College Farms, and the increase of crop was from 11½ per cent. to 15¾ per cent. at no greater cost of production. This method should be demonstrated thoroughly at all lucerne growing centres. For, not only is the yield increased but the life of the plantation is considerably lengthened.

A, K, P, N experiment with this crop was laid out in consultation with the representative of the German Potash Syndicate. The results had demonstrated that one half of the usual dressing of 20 cart-loads can be replaced with mineral manure with greater profits. The superphosphate seems more necessary than the potash. Work in this line will be continued.

Cottons.

The cotton from the various cotton growing centres was analysed and seven distinct types of cotton were noticed. But the yellow flower broad-lobed Varadi (G. neglectum malvensus) predominated in all centres except Jeur, where the Broach type predominated. At Sangola the Americon type was ¼; at other centres this type formed only a sprinkling except at Phandharpur. The narrow lobed leaf with yellow flower formed on the average about 15 per cent., but was only a sprinkling at Sangola and Málshiras. The white flowered neglectum formed only a very small percentage of the total. These were sown as pure cultures to determine the value as a crop at three centres; but as the results are not consistent we must wait another year's work.

Broach cottons were compared with local ones in Valwa táluka, but the frost vitiated the results. At some places yields of 600 lbs. and 890 lbs. of Broach kapas were obtained, which is of a better quality than the local.

II.—Implements.

The introduction of the C. T_2 plow of Ransoms Sims Jefferies has been making great headway in the black soil area of the Deccan. The Arlington No. 30 manufactured in America has been tested on College Farm and by the cultivators and is fully equal to the former It runs a little steadier. Two land side ploughs—the Gallows and South Bend chilled—have been given a trial. They throw the soil much better than ploughs of the reversible type; but they are not so much appreciated by the cultivator because he has to plough round and round instead of back and forth.

The plannet Junior hand weeder is giving excellent satisfaction.

Miscellaneous.

Prickly-pear-poison, which is reported by the Agricultural Chemist to be chiefly white arsenic, has given good sucess. Several other implements are on trial and the results will be reported later.

III.—Demonstration work.

The demonstration work of the district has been under the Divisional Inspector of Agriculture assisted by fieldmen who have toured from village to village. The principal demonstrations are the Poona Furnace, the Iron plough, the road scraper, the steeping of seed with copper sulphate, the value of the exotic groundnuts and the use of manures such as oil-cake and sulphate of ammonia as top-dressing for sugarcane and tobacco.

Annual Reports.

Annual Report of the Department of Agriculture, Bombay Presidency, for the year 1910-11.

No. 2851.

REVENUE DEPARTMENT.

Bombay Castle, 22nd March 1912.

Letter from the Director of Agriculture, No. A.—7697, dated 27th October 1911—Forwarding the annual report of the Department of Agriculture, Bombay Presidency, for the year 1910-11.

Letter* from the Director of Agriculture, No. C.—7, dated 17th January 1912.

RESOLUTION.—The administration of the Department continued to be carried on with zeal and ability by the Director and the officers of the Department. Although sanction has not been accorded by the Secretary of State to the strengthening of the College staff which the growth in the work of the Department seems to render advisable, it may be hoped that the addition of two Extra Deputy Directors of Agriculture, which is contemplated, will not only enable more attention to be bestowed on departmental work in the districts, but will also relieve the Principal and Professors of the College to a considerable extent of that portion of their duties which lies outside the College. The need for such relief and the want of more effective supervision of the district work of the Department are equally evident. With such supervision from the Deputy Directors and from the Extra Deputy Directors when appointed, in addition to the energising guidance given by the Director, the graduates and other similar employees may reasonably be expected to develop into thoroughly useful members of the Department. The Director should unhesitatingly stop the promotion, and ultimately dispense with the services, of any of them who fails to respond to the stimulus applied by the Director and his Deputies.

2. At the Poona Agricultural College, it is satisfactory to note that full provision of buildings for carrying on the College work has now been made, that notwithstanding two severe losses suffered by the College staff, the percentage of passes in the second examination in agriculture was high and in the B.Ag. examination very high, that 13 or 14 students who left the College during the year intend to make use of their knowledge on their own land, and that 27 graduates obtained appointments, 14 in the Bombay Agricultural and Revenue Departments and 13 elsewhere. Less satisfactory are the slow progress in erecting the most desirable quarters for students, and the high percentage of failures in the first examination in Agriculture. The Governor in Council has read with great interest the account of the Vernacular Agricultural School, and observes with pleasure that a commencement in this branch of education has been made on right lines and that an effective demand for an extension of similar schools has arisen. Government concur with the Director that each school should be adapted to the particular requirements of the locality in which it is established. The courses for adult cultivators which the Director describes in paragraph 11 of his report should be extended as opportunity can be found for them.

3. Chapter III of the Director's report presses strongly the necessity of good tillage, towards which the essential requisites are good implements and good traction or draught. It is a cause for congratulation that in respect of implements much progress has been made, and more is expected, in popularizing the use of suitable ploughs, while other agricultural implements (harrows, etc.) are not neglected. In regard to draught, the Director has postponed the opening of a bull-breeding farm in favour of experiments in the growing and storing of fodder. The Governor in Council entirely approves of his action. It is of little or no use to attempt to improve the supply of draught cattle by providing stud bulls, unless there is already in existence an adequate provision for the bringing up of the young stock. When this necessary provision has been made, and it is, therefore, assured that the produce of a good bull will be given a proper chance of development—a chance which it does not possess if there is no certainty of its being sufficiently nourished and tended in the years of its growth—then only can

* Not printed.

improvement of the stock be hoped for from the introduction of selected stud bulls. The fodder question lies at the root of all agricultural problems, especially in the Deccan. The attempt to increase the supply of fodder in the shape of grass for grazing by placing large areas under forest conservancy, after being given a full trial extending over many years, has had to be abandoned. The only alternative would appear to be to educate the cultivators themselves to exercise a sound conservancy of the fodder supply, and it can hardly be universally the case that for a man to store fodder is only to invite his enemies to burn it up. As a means towards educating the cultivators in this matter of fundamental importance, Government will be prepared to consider the proposals which the Director intends to submit, in the direction of systematic storing of fodder in selected localities. The education of the agriculturist in the providing of fodder and the bringing up of young stock can hardly fail to induce a marked tendency towards securing a sufficient number of plough bullocks while eliminating the numerous head of cattle which are of no service in tillage and when alive are useful only as producers of dung for fuel and "*liping*" purposes, while they consume the fodder required for the agricultural cattle, and when dead are of no value except for their bones, horns and hides. When draught cattle for tillage are insufficient, mechanical means of traction become necessary, and it would be well if the steam plough to which the Director refers in paragraph 21 of his report were taken up as a business proposition by persons of means and enterprise. Meanwhile the success of the French geared plough (paragraph 22) is satisfactory.

4. Paragraphs 24 to 32 of the Director's report summarise the research and experimental work which is more fully described in the appendices. The conclusions stated in paragraph 25 are of especial interest in view of the importance of cotton to the principal industry in the Presidency. Briefly they may be said to be: Sind and S. E. Dhárwár for exotic (long stapled) cottons (American and Cambodia); Khándesh for cotton of a short bright staple (Roseum); and the superiority over other indigenous cottons of two specially bred cottons in Surat, and of Broach seed cotton over Kumpta cotton in the Southern Marátha Country, has been established and maintained. The advance in the profitable and beneficial cultivation of groundnut in the Deccan is very marked. In regard to manures, the Governor in Council desires to give prominence to the Director's remarks that agencies for the supply of oil-cake and other concentrated manures are badly wanted and that mhowra refuse is a useful manure. The Director should consult with the Commissioner of Customs, Salt, Opium and A'bkári as to measures by which the large quantities of this refuse from the Government central distilleries and the distilleries at Uran can be made available for the benefit of the agriculture of the Presidency. The question of salt lands has been dealt with in other orders.

5. With reference to the opinion expressed in paragraph 33 of his report the Director should be informed that he is right in regarding Government as expecting individuals and the co-operative movement to provide the needed supply of dealers in implements, seed and manure. There is no more reasonable object for which bodies of agriculturists can form themselves into co-operative societies (which under the amended Act will have all the benefits of societies under the Act) than for the supply to their members of the manure, the seeds and the implements required for their agriculture, after the Agricultural Department have demonstrated the results following from the use of improved seed and selected manures and implements, and in the initial stage have supplied these to cultivators desirous of using them. If in any given important development it is found that progress is barred by the want of individual or co-operative enterprise, the Governor in Council will be prepared to consider the question of granting Government assistance if the Director can submit proposals which will not involve the checking by State intervention of private endeavours to advance the improvement of agriculture.

6. The activity of the Department in the matters of shows, demonstrations and general aid to the public was well maintained during the year, and the public responded with more frequent reference to the Divisional Inspectors for help and advice, and with an increase in the number of associations, which assisted in the organizing of shows, undertook experiments, and acted as agents for distributing implements and seed. Orders have been issued separately for the more effective co-operation of the regular branch of the Agricultural Department with the branch which is charged with the care of co-operative societies. The distribution of

bulletins and leaflets was continued, and Government are pleased to note that the Director is well satisfied with the progress made in the important matter of rousing and sustaining the interest of the cultivators in the work of the Department. The Governor in Council is aware that the Director personally gives much attention to encouraging the agricultural classes to consult him and his officers freely and fully.

7. The interesting details given in the Report of the Agricultural Engineer show that the appointment of Mr. Musto has been fully justified. Both in the advisory and executory branches of his work, valuable progress was made. As the Director remarks, skilful and careful drivers are necessary for the engines if the introduction of mechanical appliances is to make way successfully; and measures have been taken with a view to supplying such mechanics. Good results were achieved in well boring in Gujarát.

8. Since the close of the year under report, the personnel of the direction of the Department has changed, Mr. Keatinge having gone on leave and Mr. Campbell having vacated the appointment of Registrar of Co-operative Credit Societies. The Governor in Council is pleased to record his entire satisfaction with the record of work done in the Agricultural Department, which is now under review. The work of the Registrar has been reviewed separately.

R. D. BELL,
Under Secretary to Government.

To

The Commissioner in Sind, The Commissioner, N. D., The Commissioner, C. D., The Commissioner, S. D., All Collectors, including the Collectors and Deputy Commissioners in Sind,	With one copy of the Report, and with an intimation that the requisite number of copies of it will be supplied to them by the Director of Agriculture.
The Director of Agriculture and of Co-operative Credit Societies, The Commissioner of Customs, Salt, Opium and A'bkári, The Settlement Commissioner and Director of Land Records, The Registrar of Co-operative Credit Societies, The Conservator of Forests, N. C., The Conservator of Forests, C. C., The Conservator of Forests, S. C., The Deputy Conservator of Forests in charge Sind Circle, The Colonization Officer, Jamráo Canal, The Accountant General, The Director of Public Instruction, The Principal of the Agricultural College, Poona, The Educational Department of the Secretariat, The Political Department of the Secretariat, The Public Works Department of the Secretariat, The Financial Department of the Secretariat, The General Department of the Secretariat, The Non-official Members of the Legislative Council.	With copies of the Report.
The Government of India, The Under Secretary of State for India.	By letter.

No. of 1912.

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Exhibitions were held at Sholápur and Peth, where the district staff was assisted by the Farms. Smaller demonstrations have been held at Mahoud, Sholápur, Junnar, Poona. A party of cultivators was sent to Surat to study the superior cultivation of that place.

IV.—Details of experimental work carried on outside of the Farms.

(1) "Dry Farming" or work in moisture conservation.

This work was carried on at two centres, in Akalkot, Sholápur District, and Ahmednagar.

The cropping scheme was similar in both cases and included ploughing *vs.* no ploughing, subsoiling, more thorough seed bed preparation spacing and seed rate trials and intertillage. At Ahmednagar the jowár plots were almost ruined by a severe frost on February 2nd, so that the results are for fodder only and very low. The Akalkot series were very useful.

The following statement shows rainfall at Nagar for 1909 and 1910:—

Rainfall in inches for 1910-11.	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.	Total.
	0·00″	0·33″	8·59″	6·45″	3·21″	12·73″	2·44″	3·55″	0·00″	0·00″	0·00″	0 00″	37·30″
Average rainfall ...	0·37	0·78	5·84	3·14	2·6	7·12	2·0	0·41	0·27	0·14	0·29	0·26	22·68

Latitude of Nagar is 19° 8″. Longitude is 17° 55″. Elevation is 2,180 feet above sea level.

The land is taken up for a lease of five years. The total area is 15 acres. The soil is characteristic black soil from Deccan trap of a depth of 4 to 6 feet. There are more or less small lime nodules scattered here and there. There are two plots which rotate with each other, Gram and Jowar being the crops principally experimented with. One of these plots was in a foul condition with regard to weeds. The other was fairly clean.

This year in the field in which gram was grown there was no differential treatment except ploughing, but there was one plot that was fallow last year that had received only harrowing.

The crop was considerably injured by the frost but the results may be considered reliable.

Five plots were ploughed with the usual country plough and 10 with the iron plough. The average yield of country plough was 430 lbs. gram and that of deep ploughing 480 lbs.—a gain of about 11⅔ per cent. at a less cost of operation.

The fallow plot only gave 414 lbs. The rainfall was so abundant that the moisture held over by the fallow plot was no advantage. The yields of all plots would no doubt have been double that reported but for the frost.

The field planted to Jowar was an absolute failure so far as grain went, and only a meagre crop of very poor fodder was obtained.

The details are reported for what they are worth.

Name of treatment.	Yield of Kadbi (fodder).	
	Treated plot.	Untreated plot.
Deep Ploughing	655	578
Thorough harrowing	588	770
Sub-soil packing before sowing ...	574	496
Often intertilled	482	574½
With 9″ drill half seed rate full *vs.* half ...	916 (half seed rate).	1,120
With 18″ drill	1,608	988
Average of above	1,262	1,054
Drills 9″ *vs.* 18″	1,298 (18″ drill),	1,018
Farm yard manure *vs.* no Manure ...	1,544	1,148 (no Manure).
Complete Artificial	1,276	1,148
Green Manure + 18″ Sulphate of Potash and Superphosplate	936	1,148

It is not safe to draw inferences from such small yields unless they are marked or in corroboration of former results. The value of deep ploughing is confirmed. The value of the 18″ drill over the 9″ is also again emphasised and manuring has increased the yield.

The inundation experiments at Ráhuri were continued, the inundated wheat yielding 754 lbs. of grain and 1,422 lbs. of jowár and fodder per acre. The frost made the grain a failure but the fodder is very high for the year and the wheat yield is good for a dry crop. The heavy rain of the season has made inundation less beneficial than in a dry year.

The remaining dry farming experiments were carried out at Akalkot where a very uniform piece of ground was secured of 10 acres and the different treatments of soil studied. In each case, except the ploughing series, the averages are from 10 guntha plots and in the plough test from plots 5 acres each. Ploughing is not done yearly in this region but only resorted to once in several years. I am also inserting the results of three crop tests made on 10 guntha plots in cultivator's fields adjoining the experimental area.

The details appear below :—

Name of treatment.	Treated plot.		Not treated.		Gain.		Cost of treatment.
	Grain.	Kadbi.	Grain.	Kadbi.	Grain.	Kadbi.	
							R. a. p.
Ploughing *vs.* no ploughing ...	681	1,121	454	688	227	433	3 2 0
Thorough harrowing *vs.* ordinary.	542	872	584	907	—42	—35	2 0 6
Subsoil packing *vs.* not ...	569	883	582	809	—13	74	*0 12 3
Double distance *vs.* ordinary ...	628	1,008	528	943	100	65	0 0 6
Half-seed rate *vs.* full ...	613	908	514	976	99	—68	0 2 0
Thorough inter-tillage with 18″ drill *vs.* ordinary ...	540	889	524	914	16	—25	5 4 0
Half-seed rate with 9″ drill *vs.* full.	584	932	514	961	70	—29	0 2 0
Inter tillage with 9″ drill *vs.* ordinary ...	517	969	503	969	14	...	3 3 0
Ordinary *vs.* cultivators ...	416	792	369	834	47	—42	...

* Difference in results is marked with an asterisk. They do not cover experimental error and, therefore, these treatments have not yielded any results.

Ploughing has increased the yield by 33⅓ per cent. 18″ drill with half seed rate has increased the yield by 1⅔. These two results agree with Nagar results. The other treatments so far have given very little results.

With 9″ drill one-half the seed rate increases the yield by 10 per cent.

Our ordinary plot which was supposed to be exactly like the cultivator's is 10 per cent. better than the cultivator's plot. The value of ploughing and thinner seeding for dry cultivation is well proved even in the case of fodder.

(2) BÁRÁMATI DEMONSTRATION STATION, 1910-1911.

Established 1906 ; North Latitude 18-8° ; East Longitude 74-37 ; Elevation 1,774 feet above sea-level ; Area—27 acres.

Rainfall.—Rain-guage was not fixed on the plots at Málád but the following are the figures obtained from the Mámlatdár's Kacheri at Bárámati, one mile from the demonstration plots :—

Rainfall for the year. 1910-11.	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.	Total.
	″	″	″	″	″	″	″	″	″	″	″	″	″
	0·00	0·14	4·36	3·03	4·57	6·77	1·49	0·18	0·00	0·11	0·00	0·00	20·65
Average ...	1·01	2·17	3·90	2·65	1·52	6·65	3·81	0·69	0·31	0·25	0·07	0·22	23·26

The rainfall for the year was equal to the normal. Heavy showers were received in August and September and season extended in the middle of November, thus assisting especially the rabi crops.

Distribution of area under different crops.

Out of the whole area of 27 acres, 10 acres were already affected by salt efflorescence, but this area increased gradually and at the end of three years it became to nearly 14 acres. This piece was useless for other experiments but the land was selected with the intention that both sugarcane and salt experiments can be conducted under one man's supervision.

Out of the remaining 13 acres, piece of 8 acres was on higher level and was specially selected for sugarcane experiments.

The following will show the area under different crops :—

Plot No.	Area.		Crop and purpose.
	Acre.	Gunthas.	
1—12	3	24	Sugarcane experiment.
5	2	10	Kharif javar varieties.
2	...	36	Inundation experiment with wheat.
2	1	36	Do. do. javar.
...	3	...	Hundi javar for fodder.
...	...	4	Rice seedlings.
...	11	30	Total under crop.

The details of water experiment are shown in the statement below :—

Water Experiment.

To demonstrate the quantity of water that is most economical for sugarcane and the best interva fails application.

The quantity of the manures was the same in all the plots, *i. e.*, 30,000 lbs. F. Y. M. = 200 lbs. N. before planting, are 84,000 lbs. of Sábarmati castor-cake = 150 lbs. N. at earthing up.

Plot No.	Interval between two waterings.		Irrigation inches of rainfall each watering.	Total quantity of water in 12 months cubic feet.	Weight of cane in lbs. per acre.	Weight of juice in lbs. per acre.	Weight of gul in lbs. or acre.	Value of gul.	Value manure per acre.	Total cost of cultivation.	Profit or loss per acre.	Percentage juice to cane.	Percentage gul to juice.	Percentage gul to cane.	Remarks.
	Hot weather.	Cold weather.													
								Rs. a. p.	Rs. a. p	Rs. a. p.	Rs. a. p.				
1	According to local fraction.				91,180	61,820	11,563	963 13 0	246 15 8	532 14 8	435 14 4	67·8	18·7	12·6	
2	6	8	1·60	290,400	91,820	61,432	10,849	908 8 4	246 15 8	521 8 0	387 0 4	66·9	17·7	11·8	
3	10	12	2·59	290,400	95,808	66,120	11,836	991 4 4	246 15 8	528 12 0	462 8 4	68·3	17·9	12·2	
4	8	10	2·12	290,400	93,700	67,838	12,544	1,050 9 0	246 15 8	519 0 0	531 9 0	68·7	18·5	12·6	
5	8	10	2·38	387,200	65,344	44,304	8,108	676 8 8	246 15 8	506 4 0	170 4 8	67·8	18·3	12·3	
6	8	10	1·41	193,600	86,448	59,216	11,192	937 5 4	246 15 8	527 1 4	410 4 0	68·5	18·9	12·9	
7	8	10	2·12	290,400	75,340	51,716	9,110	762 15 6	181 8 0	518 9 1	244 6 5	68·7	17·6	12·0	
	(Drainage experimental plot with a ditch all round).														

From this it will be seen that about 290,000 cubic feet of water given in application of about 2″ depth at a time in intervals of 8 days in hot weather and 10 in cold will produce the best results with sugarcane. This is in exact conformity with all our previous results. If the amount is increased or the interval lengthened loss will result in out-turn.

Manure Experiments with Sugar-Cane.

To study the effect of safflower and caster-cakes on the yield of gul.—The manure plots were somewhat affected by salt, so that the results are not of great experimental value :—

Plot No.	Treatment.		Weight of cane per acre.	Weight of juice per acre.	Weight of gul per acre.	Value o gul per acre.	Cost of cultivation per acre.
	Before planting.	At earthing up.					
						Rs. a. p.	Rs. a. p.
8	30,000 lbs. F. M. Y. = 200 lbs. N.	2,727 lbs. safflower-cake = 150 lbs. N.	60,488	40,160	7,228	605 0 8	380 5 0
9	30,000 lbs. F. Y. M. 50 loads = 350 lbs. N.	2,500 lbs. Safflower-cake (5 khandies) = 150 lbs. N.	60,012	40,088	7,296	611 0 8	455 0 0
10	50 cart loads F. Y. M. = 350 lbs. N.	4,000 lbs. castor (8 khandies) cake = 150 lbs. N.	8,652	53,640	10,084	345 1 4	512 2 0

Plot No.	Treatment.		Profit or loss per acre.	Per cent. of juice to cane.	Per cent. of gul to juice.	Per cent. of gul to cane.
	Before planting.	At earthing up.				
			Rs. a. p.			
8	30,000 lbs. F. Y. M. = 200 lbs. N.	2,727 lbs. safflower-cake = 150 lbs. N.	224 11 8	66·4	18·0	11·9
9	30,000 lbs. F. Y. M. (50 cart loads) = 350 lbs. N.	2,500 lbs. safflower-cake (5 khandies) = 150 lbs. N.	156 0 8	66·8	18·2	12·1
10	50 cart loads F. Y. M. = 250 lbs. N.	4,000 lbs. castor-cake (8 khandies) = 150 lbs. N.	332 15 4	68·2	18·8	12·3

Castor-cake has shown an increase over safflower-cake when applied on some Nitrogen basis; this is not in confirmation of previous experience of experiments this year at Karanja.

A decrease of the Nitrogen did not lower the out-turn.

Plough distribution work.

Other important works done on this sub-station are the iron plough distribution and sending out of trained gul-makers.

During the year about 100 ploughs were sold through this sub-station to cultivators of different villages of the Nira valley and even of Phaltan State.

Jowár experiments.

For the last three years we were trying to introduce some kharip jowâr of different varieties. The following varieties were selected :—

(1) Chapti.

(2) Sholapuri.

(3) Perio.

(4) Utavli.

(5) Gidgap.

All the varieties gave best results but the cost of cultivation exceeded the out-turn value, majority of the charges being of watching the crops and scaring the birds.

Some cultivators have grown the kharif jowár this year but they had to cut it as fodder instead of allowing to stand and eaten up by birds.

(3) KARANJA DEMONSTRATION PLOTS.

Situation.—The plots were selected on Ráo Báhádur Kinjale's estate at Karanja 18 miles from Bárámati.

Object.—In laying out the demonstration plots here the object was three-fold—Manure, water and working of the power crusher.

1.—Manurial Experiments.

These were undertaken in order to demonstrate to the cultivators of the upper tract of Nira Left Bank Canal the beneficial results obtained on Mánjri and Bárámati about different kinds of manures, etc., to sugarcane and thus to corroborate the results.

The Agricultural Department supplied the manures for only 3 plots of manurial experiments and the owner to take the produce in return for the cultivation charges.

Statement shows the details of manurial experiments.

Plot No.	Treatment per acre.		Weight of cane per acre.	Weight of juice per acre.	Weight of gul per acre.	Value of gul.	Cost of cultivation per acre.
	Before planting.	At earthing up.					
						Rs. a. p.	Rs. a. p.
1	30,770 lbs. F. Y. M. = 200 lbs. N.	2,500 lbs. safflower-cake = 150 lbs. N.	91,364	63,954	11,784	982 0 0	523 9 11
2	50 cart loads of F. Y. M. = 223 lbs. N.	9 khandies castor-cake = 220 lbs. N.	91,724	64,574	11,824	985 5 4	587 9 3
3	30,770 lbs. F. Y. M. = 200 lbs. N.	375 lbs. Ammonium Sulphate after 2 months 1,250 lbs. safflower-cake = 75 lbs. N. At earthing up.	93,112	65,644	12,140	1,011 10 8	536 14 2

Plot No.	Treatment per acre.		Cost of manure per acre.	Profit or loss.	Per cent. of juice to cane.	Per cent. of gul to juice.	Per cent. of gul to cane.
	Before planting.	At earthing up.					
			Rs. a. p.	Rs. a. p.			
1	30,770 lbs. F. Y. M. = 200 lbs. N.	2,500 lbs. safflower-cake = 150 lbs. N.	178 4 3	458 6 1	70·0	18·4	12·9
2	50 cart loads of F. Y. M. = 223 lbs. N.	9 khandies castor-cake = 220 lbs. N.	242 3 9	397 12 1	70·4	18·3	12·8
3	30,770 lbs. F. Y. M. = 200 lbs. N.	375 Ammonium Sulphate after two months 1,250 lbs. safflower-cake = 75 lbs. N. At earthing up.	191 8 6	474 12 6	70·5	18·5	13·3

From the result statement of the manure experiments it will be seen that plot No. 3, which received a top-dressing of Sulphate of Ammonia and safflower-cake, improved in yield than saffl ower-cake alone or the castor-cake.

The continuation of Ammonium Sulphate and safflower-cake as top-dressing has been also proved very beneficial at Mánjri and Bárámati. This is a very satisfactory result and in agreement with the early reports by Mr. Mollison and later ones by myself at Mánjri, in no sugar growing tract in the world is so large an application of Nitrogenous manures applied to this crop. It it believed that, throughout the Nira and Mutha valleys, application from half to one-fourth more than necessary are applied.

Plot No. 1 which got farm-yard manure and safflower-cake as top-dressing on the basis of 350 lbs. of Nitrogen per acre has given practically equal out-turn to that of plot No. 2 which was heavily manured.

2.—Water experiments.

These were laid out but could not be carried through for various reasons.

3.—Working of the Power Crusher.

A five-roller American power crusher, was installed at Ráo Báhádur Kinjale's estate last year at Karanja.

It is an American plant made by Geo. L. Squire, Buffalo, New York, America, and supplied by the Empire Trading Company, Bombay.

This was the second year of the power crusher. It has worked very smoothly for two seasons.

No tests were taken but the average extraction obtained from the crushing of our experimental plots was about 70 per cent. or even more, which is equal to the extraction obtained on the Mánjri Farm of the English three-roller mill.

The capacity of the crusher was found on an average to crush two and a half panfulls of juice or two tons (small) of cane per hour.

On calculation it was found that the expenses for crushing and boiling per pan was Re. 0-12-2. Now if the cartage for bringing the cane for a mill is taken in account, the total cost comes to Rs. 1-1-2. But this can be minimised by using light rails and wagons on big estates to carry the cane to the central crushing station.

(4) EXPERIMENTS CARRIED OUT BY THE DIVISIONAL INSPECTOR.

Sugarcane manuring.

These were carried out at four centres in Sátára District on cane under well irrigation. The statement below shows the details :—

Serial No.	Name of place.	Plot No.	Manure per acre.	Yield of gul in lbs. per acre.	Surplus yield per acre against plot No. III.	Value of surplus at Rs. 22 per palla of 240 lbs.	Cost of manure per acre.	Profit per acre deducting the cost of extra manure.	Loss per acre.
						Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
1	Kasegaon ...	I.	275 lbs. Ammonium Sulphate ...	8,607	1,927	175 3 0	47 8 0	127 11 0	.....
			800 lbs. safflower-cake						
			15 cart loads of F. Y. M. sheep folding						
		II.	1,600 lbs. safflower-cake ...	7,037	377	34 4 6	40 0 0	.....	5 11 6
			15 cart loads of F. Y. M. ...						
		III.	15 cart loads of F. Y. M. ...	6,680	...	.....	.....	.....	.....
2	Yellur	I.	260 lbs. Ammonium Sulphate ...	6,000	2,408	218 14 6	46 0 0	172 14 6	.....
			800 lbs. safflower-cake						
			20 cart loads of F. Y. M. ...						
		II.	1,600 lbs. safflower-cake ...	4,676	1,084	48 14 6	40 0 0	.....	58 14 6
			20 cart loads of F. Y. M. ...						
		III.	20 cart loads of F. Y. M. ...	3,591	...	.....	.....	.....	.....
3	Chikurde ...	I.	200 lbs. Ammonium Sulphate ...	5,453	1,364	124 0 0	35 0 0	89 0 0	.....
			600 lbs. safflower cake						
			20 cart loads of F. Y. M. ...						
		II.	1,200 lbs. safflower cake	6,900	2,811	255 8 9	30 0 0	225 8 9	.....
			20 cart loads of F. Y. M. ...						
		III.	20 cart loads of F. Y. M. ...	4,089	...	.....	.....	.....	.....
4	Ichalkaranji ...	I.	250 lbs. Ammonium Sulphate ...	5,600	1,244	113 1 6	42 8 0	70 9 6	.....
			700 lbs. safflower-cake						
		II.	1,400 lbs. safflower-cake ...	4,664	308	28 0 0	35 0 0	.....	7 0 0
		III.	Farm yard manure	4,356	...	.....	.....	.....	.....

It will be seen that Ammonium Sulphate in all cases has proved highly profitable and more profitable than cake. This is in agreement with the experiments in the canal irrigated areas.

Analysis of Sholápur cottons.

An attempt was made to analyse the Sholápur cottons and the statement below gives the details :—

Name of village from which seed was brought.	Name of táluka of the village.	Total number of plants in each plot.	White-flowered broad-lobed.	Yellow-flowered broad-lobed.	White-flowered harrow-lobed.	Yellow-flowered harrow-lobed.	Broach.	Upland Georgian.
Peliva ...	Fundharpur ...	166	6	63·25	1·8	17·46	·6	16·26
Jeur ...	Karmála ...	123	...	23·57	·81	10·56	63·4	4·06
Tadola ...	Bársi ...	93	...	69·9	6·45	13·9	4·36	5·37
Pomalwádi ...	Karmála ...	74	...	40·5	1·3	10·8	40·5	6·7
Temburn ...	Do. ...	49	...	59·18	2·03	14·3	18·3	6·1
Málsiras ...	Málsiras ...	75	...	76·0	4·0	14·6	4·0	1·3
Akluj ...	Do. ...	88	...	58·0	3·4	6·8	25·0	6·8
Vairag ...	Bársi ...	51	...	80·4	...	9·8	5·88	3·92
Sángola ...	Sángola ...	36	...	55·5	...	19·44	2·8	22·2
Bhalavin ...	Pandharpur ...	83	1·2	56·6	...	20·4	14·4	7·2

It will be seen that the cotton at all centres is a mixture in which the yellow-flowered broad-lobe leaved Varadi type predominates except at Jeur, forming from 40 per cent. at Karmála to 70 per cent. at Bársi. Broach type forms 63 per cent at Jeur, 40 per cent. at Pomalwádi and 25 per cent. at Akluj, while the American forms 2·2 per cent. at Sángola and 16 per cent. at Peliva. The other mixtures are only in small quantities.

Groundnut varieties.

Groundnut varieties were compared at Sholápur, Nagar, Islámpur and Shirála of Válva Táluka. The details are given below; the results at the farms are included for information :—

Name of variety.	Outturn per acre.						
	College farm.	Mánjri farm.	Sholápur.	Nagar.	Islámpur.	Shirála.	Average.
Virginia	2,670	4,016	544	7,600	1,700	800	2,888
Big Japan	1,990	4,236	140	2,500	1,904	1,120	1,981
Pondicherry ...	2,590	3,671	344	2,100	1,732	600	2006
Local	1,380	2,720	140	.....	... ..	...	.....
Mauritius	2,670	3,987	584	3,060	1,856	600	2,126
Egyptian	1,850	4,478	720	3,040	1,840	720	2,108
Small Japan ...	1,820	2,648	40	2,140	864	500	1,335
Spanish pea-nut ...	1,970	2,730	260	2,000	1,268	580	1,469

Nagar results are for garden cultivation. Mauritius and Egyptian, the new varieties are very promising. Virginia and big Japan are nearly equal, as also are the small varieties of small Japan and Spanish pea-nut.

Groundnut manurial experiments.

Manurial experiments were tried at four centres and the results are given below :—

Place.	Veriety.	Out-turn per acre.				
		Quicklime 2,000 lbs. per acre.	Ashes 2,500 lbs. per acre.	Nitrate of Potash 448 lbs. per acre.	Sulphate of Potash 3 14 lbs. per acre.	No manure.
Mánjri Farm ...	Pondicherry ...	3,867	3,880	3,661	3,567	3,332
Islámpur	Big Japan ...	2,032	1,744	2 312	2,332	1,904
Shirála	Do. ...	1.204	1,120	1,400	1,500	1,120
Sholápur	Do. ...	2,572	2,240	2,096	1,644	1,360

The cost for lime ashes Nitre Sulphate of Potash in the quantities applied is Rs. 24, 6, 54 and 10 respectively which means that an increase of 600, 150, 1330 and 250 lbs. respectively over unmanured must be obtained to make it pay. These increases have only been obtained in the case of lime at Sholápur, ashes in Mánjri and Sholápur, Sulphate of Potash in all cases except Mánjri where the increase almost pays the cost. The profits over cost in the case of lime at Sholápur come to 66⅔ per cent. On the investment of ashes at Mánjri and Sholápur the expense is very little and the increase very considerable. The Sulphate of Potash has paid an average profit of 33⅓ per cent. on investment.

We can sum up the results as follows :—Lime in small quanties of ¼ ton per acre would probably be profitable everywhere and a heavy dressing at Sholápur would pay well. Ashes are useful and profitable at all centres and should be generally used as far as available for this crop.

Nitre is not profitable, nor does there seem any possibility of its being so.

Sulphate of Potash in quantities of about 2 cwts. per acre may be depended upon to give a profit of about 25 per cent. on investment and is to be recommended.

The statement below shows the amount of increase necessary for profit and that actually obtained.

No.	Name of manure.	Increased out-turn in lbs. necessar to cover increased expenses.	Mánjri.		Islámpur.		Shirála.		Sholápur.	
			Increase in out-turn.	Percentage profit on investment.	Increase in out-turn.	Percentage profit on investment.	Increase in out-turn.	Percentage profit on investment.	Increase in out-turn.	Percentage profit on investment.
1	Quick lime	600	335	Nil.	128	Nil.	84	Nil.	1,212	66⅔
2	Ashes	150	548	266	Nil.	Nil.	Nil.	Nil.	880	500
3	Nitrate of Potash ...	1,350	329	Nil.	408	Nil.	280	Nil.	736	Nil.
4	Sulphate of Potash ..	250	235	Nil.	428	70	380	50	284	3

J. B. KNIGHT,
Professor of Agriculture.

APPENDIX F.

Summary of Experimental Work done under the Economic Botanist, 1910-1911.

(1) *In Ganeshkhind Botanical Garden, Kirkee.*

The abundant rainfall gave an excellent start to all vegetation, but the frost of February 1911 severely checked growth and ruined some experiments.

The study of many questions concerning mango culture has occupied attention during the year. A census of the mango trees in the garden and a classification of these into their true varieties has been carried out. Grafting of the mangoes in various ways and budding the mango have been tried. Budding proved unsuccessful and whip grafting only partially successful. No success was obtained in the grafting of mango scions on stocks of other genera of the same Natural Order. A considerable number of new varieties have been planted, and manurial experiments are being carried out on these. Pruning of the trees according to a system was attempted for the first time. So far only increased vegetative growth has resulted. The progress of this growth is being watched. Extensive experiments in crossing the mango were tried. Out of one hundred and forty-two crosses made, twenty-three set fruit, but the frost destroyed them. It was found that mango flowers could set fruit without insect agency. A curious malformation of the inflorescence has been the subject of study and will be dealt with in a separate series of papers. Experiments in the packing of mangoes for transport showed that the package must be light, with plenty of air circulating through it, and impervious to thieves. A simple basket with a hay packing gave the best results as to the keeping of the mangoes in good condition, but such a package is not thief-proof.

In connection with oranges, lemons and other species of citrus, experiments have been continued to find out the best stock for budding each variety on. Eleven varieties were budded on the Jambori stock, one hundred and sixty-seven buds in all being inserted. As was to be expected the buds of Jambori itself united most readily, next came Kagdi limbu, and Sakhar limbu. The species that united with most difficulty was Mahalung. It was found that root pruning and drying off followed by manuring and watering forced the Nágpur orange trees to flower. The new plantation of Nágpur oranges was transplanted to more calcareous and better drained soil where they are doing excellently.

The collection and planting of selected varieties of guavas from all parts of the Presidency continues. The main plantation fruited for the first time this year and this gave opportunity for classifying the plants and arranging for further experimental work with them. The whip grafting of guavas has not proved very successful. The testing of the effects of repeated layerings is being continued.

From experiments made with papayas it would appear that the female flowers can set fruit without the influence of pollen. In a new plantation hermaphrodite plants again occurred in large proportion. Potatoes proved a good intercrop for papayas. The thinning of fruits turned out to be a most necessary and useful operation, thinned fruits reaching eight pounds in weight, and being valued at four annas each. The germination of papaya seeds presents certain peculiarities which will be dealt with in a separate paper when material is complete.

A new plantation of Bhokri grape vines was laid out, and similar blocks of local varieties will be planted in the future. The results of the spraying experiments for mildew are recorded in Bulletin 45 of the Department. Cattle refused to eat the leaves of the supporting plant "Pangara" (Erythrina indica) when these leaves were sprayed.

Bagging of pomegranates was continued this year with waxed paper bags. These, however, did not prove very satisfactory as they retained rain water and fruits rotted. Ring irrigation gave on the whole better results than basin irrigation. The using of weeds as a mulch had no deleterious effect on the trees though there is as yet no marked advantage from this practice.

The Bourbon cotton plot gave a very poor yield this year due to the frost and to its not having recovered from a severe pruning. The plants are in their sixth year. In their first year they did not boll. Their second, third and fourth year crops were good. Then heavy pruning was resorted to and the crops since have been poor.

Among the hedge plants tried, that known as Devbabul (Acacia farnesiana) seems most promising on account of its ready germination and quick growth combined with its strength and thorny habit. Karwand (Carissa carandas) has proved very difficult to propagate either by seeds or cuttings.

Dwarf rubbers were not successful. Germination was poor and the climate did not seem to suit them. Manihot dichotoma is the most promising.

Oporto onion seed sown in August gave much better results than when sown in March. The shape of the onions still leaves something to be desired.

A certain number of new plants have been introduced.

Eri silk worms have been kept throughout the year and eggs distributed.

(2) In Bassein Botanical Garden.

The improvement and development of the garden have been continued.

The year's experimental work on plantains shows, so far as work has yet been carried, the following results: (1) For plantains planted in July the main flowering time is the following May. (2) There has not yet appeared any definite correlation between the size of the sucker and the time of flowering. (3) The varieties Sahasraphali and Pata Maduranga Bali will probably turn out to be early varieties. (4) The few bracted varieties have correspondingly large fruits.

Castilloa rubber is in excellent condition. The other varieties of rubber trees are not doing well.

The collection of mango varieties has been augmented. Experiments in budding the mango gave little success. Those buds which did unite with the stock had their wood core retained in them. Plants grafted by the whip method are growing well and are making fine straight stems.

The cocoa plantation makes steady progress. No fruit has appeared yet.

Lac has been tried for the first time this year. Bor trees were inoculated. The result of two inoculations is 44 lbs. 12 oz. from eighteen trees. Ants and a certain moth disturbed the lac and there was some suspicion that squirrels gnawed the incrustation. Ants were prevented ascending the trees by a cone of sacking soaked in crude oil emulsion and spread on wire.

Eri silk was bred through three cycles. At first the yield was good, but some disease set in and the last brood was completely carried off by it. The first gave 6,700 cocoons weighing 5 lbs. 6 oz. from a laying of 8,200 eggs.

Coffee flowered for the first time this year. Fruits are now forming. This is second year of these plants' life. Plantains have been used as a shade crop. The shade was reduced by half in the second year.

The lemon-grass distilled by the Alembic Chemical Company gave an oil percentage of 0·5. The oil was not good in quality, being deep brown in colour and requiring bleaching. The cost of extraction was about Rs. 8 per lb. The pulp was too small in amount to be satisfactorily tested as a paper material.

(3) Other work.

The question of combating grape vine mildew has been pursued experimentally at Násik, Mundwa and Ganeshkhind. The results of this year's work are embodied in Bulletin No. 45 of this department. The spraying with Bordeaux mixture has a marked beneficial effect.

The study of a remarkable malformation of the mango has been carried out at various places. The results of the observation so far made will shortly be published.

The experimental sowing of the seed of wild fodder plants has been taken in hand to see if by this means waste land can be utilised. Mr. Bhide, Assistant Economic Botanist, has assisted in this.

The Assistant Professor of Botany, Mr. H. M. Chibber, has done a considerable amount of research on the minute structure of the pân plant. This will shortly be published. He has also collected a considerable amount of information regarding pân cultivation, has begun the classification of castor varieties and the study of the Ecology of the Presidency.

Research on plant diseases due to fungi has been carried on by Mr. S. L. Ajrekar, Assistant Professor of Mycology, and Mr. G. S. Kulkarni, Assistant Mycologist. The former has been investigating grape vine mildew, castor rust, a papaya disease, and a new fungus discovered by him on a wild plant, Olea dioica. The latter has devoted his attention to tur wilt, tikka disease of groundnut, smut of bajri and red rot of sugarcane. Facts regarding the life history and distribution of the latter disease, and remedies for the disease, have been published in Bulletion No. 44 of this department.

Various orange gardens in this Presidency have been visited by Mr. H. P. Paranjpye, Assistant Economic Botanist, and certain diseases of orange groves are being investigated and remedial measures attempted.

The work of my other assistants Messrs. Patwardhan, L. B. Kulkarni and Prayag is contained in the report of the work done in Ganeshkhind Graden.

WILLIAM BURNS,
Economic Botanist.

APPENDIX G.

Report of the Agricultural Chemist for the year 1910-11.

1. The office and laboratory of the Agricultural Chemist to the Government of Bombay have been in my charge during the whole of the year under review with the exception of the period from March 25th 1911 to May 26th 1911 when Mr. W. Burns acted in my place. The full accommodation for the work in the new agricultural college buildings was not available until nearly the end of the year, but this is now in my charge, and there will be no difficulty in the future with regard to space for the work.

2. The routine analytical work of the laboratory maintains its volume. The following figures indicate the number of samples received in each of the last five years:—

Kind of sample.	Number of samples received.				
	1906-07.	1907-08.	1908-09.	1909-10.	1910-11.
Soils	67	101	311	347	281
Manures	43	105	91	205	184
Feeding stuffs	17	41	17	107	33
Water	22	80	266	4 3	328
Gul and sugar	32	76	7	56	10
Beet root	...	...	36	11	1
Oil seeds and oils... ...	47	98	116	278	190
Milk	233	666	257	545	73
Condensed milk	...	...	2	...	1
Cream	123	1	1	...	...
Butter and Ghee ...	2	2	2	16	12
Tapioca	...	...	...	46	9
Miscellaneous	10	22	17	104	94
Total ...	596	1,192	1,153	2,119	1,216

The apparent decline during the present year is principally due to the fact that the daily control of the milk at the Poona Civil Dairy, formerly done at this laboratory, is now carried out at the dairy itself.

3. By far the larger proportion of these samples are received from the various farms and offices of the agricultural department. There are, however, a constantly increasing number of inquiries addressed and samples sent from private individuals in all parts of the Presidency. As I have always maintained, this is really the test of the success of the work. So long as little else than departmental work is done, so long must it be considered that only half the purpose of the laboratory is being served. It is only when it becomes the place to which cultivators send their difficulties, or merchants buying and selling agricultural and other products send these products for analysis, that one can feel it is fulfilling its purpose. The number of samples which have been received from private individuals and firms during the last four years is as follows :—

	1907-08.	1908-09.	1909-10.	1910-11.
Soils	15	14	23	59
Manures	12	11	11	73
Feeding stuffs	3	2	17	11
Water	11	16	15	38
Milk	...	4	17	2
Butter and Ghee	...	...	13	10
Miscellaneous	...	...	41	56
Total ...	41	54	137	249

The progress in the direction of being utilised by the general agricultural public is, therefore, very considerable during the past year.

4. As is well-known, there is an enormous demand for oil-cake and other concentrated manures in the highly cultivated sugarcane tracts in the Deccan. The favourite of these in the Mutha Canal tract is castor-cake chiefly obtained from Gujarát or Bombay oil mills: in the Nira Canal tract safflower cake is usually preferred, that made in the country *ghâni* being almost always used. I am informed by the merchants that they have

great difficulty in getting rid of other cakes as manures, though some of them, notably rape-cake, is rather better than the average castor-cake produced on this side of India. I cannot refrain from calling attention to the poor quality of the castor-cake as a manure in the Bombay Presidency compared with that produced in Bengal and Madras Presidency. It rarely contains much more than four per cent. of nitrogen, its most valuable manurial constituent, while 6 to 7 per cent. of this constituent is common elsewhere. I suppose it is the nature of the seed grown here which gives this large difference. The following are analyses of the castor-cake we usually obtain :—

	1	2	3	4
	Per cent.	Per cent.	Per cent.	Per cent.
Nitrogen	4·47	4·86	4·27	4·86
Phosphoric Acid	1·55	1·85	2·62	1·94
Potash	1·02	·85	1·36	1·25

While the quality of the castor-cake, though poor, is fairly constant, that of the other great oil-cake manure in use—safflower cake—is subject to very great variations. At its best, it is perhaps the best manure oil-cake known: as it often occurs, and where no decortication has taken place, it is considerably less in value than castor-cake. The ollowing analyses indicate this :—

	1	2	3	4	5
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Nitrogen	7·60	6·97	8·78	3·47	3·27
Phosphoric Acid	2·83	1·83	2·16	·50	·92
Potash	2·01	1·35	2·08	1·48	1·00

This enormous difference shows the importance of analysis of the material before purchase. It accounts for and justifies the prejudice of the cultivators for castor-cake simply because it is more reliable.

2. I have spoken of the fact that other cakes are in the market, which are very good manures, but which the cultivators will not use as a rule, on account of ignorance of their value. Of these perhaps the most useful is rape-cake, but occasionally nigerseed cake appears on the market at a price which makes it as good value as any of them for manure. Analyses of these follow :—

	Niger Cake.	Nigar Cake.	Rape Cake.
	Per cent.	Per cent.	Per cent.
Nitrogen	4·10	5·35	5·43
Phosphoric Acid	1·72	1·78	1·05
Potash	·52	2·05	1·44

There are several varieties of fish which are always on the market as concentrated manures, and I am often asked which is to be preferred. Analyses show that there is not usually much difference, but the following figures may serve as some sort of guide. The price at any rate seems little indication of the manurial value :—

	Nitrogen.	Price (per Bengal maund).
	Per cent.	Rs. a. p. Rs. a. p.
Sukat	7·92	3 4 0 to 4 0 0
Dhomee	9·05	1 4 0 to 1 8 0
Chingli	8·91	4 4 0 to 5 0 0
Panch bhel (mixed fish)	7·29	1 2 0 to 1 12 0

5. An interesting inquiry came to hand from North Kánara in connection with a request that the people should be allowed to use salt, properly denatured, as a manure for mango trees without paying duty. The question was asked as to whether there was any justification for the use of salt as a manure for mango trees. I am almost sure that the salt is used in connection with mango trees as a means of preventing the soil from completely drying up. Its addition would certainly keep the soil more moist, and would

be in line with the practice in Egypt of adding scrapings from salt land to the trees. The only difficulty about the question is how best to denature the salt. The method suggested was to mix it with coal tar, but from this I was able to prepare, by the simplest possible recrystallisation, an edible salt. I think probably the only method for this purpose is the addition of night soil in small quantity to the salt intended for agricultural purposes.

6. There is always a search going on in some places for new fodders, and the question has again been raised as to whether *babul* pods cannot be used for this purpose. They are used constantly for sheep feeding, and it has been asked, as many times before, why they should not be utilised for cattle feeding also. They form a fairly rich food as the following analysis shows :—

	Per cent.
Moisture	5·50
Oil, etc.	2·20
*Proteids	11·63
Soluble Carbo-hydrates and Tannin	59·30
Woody fibre	16·47
Ash	4·90
	100·00

* Containing Nitrogen 1·86.

Judged by this analysis they should form a nutritious fodder, and the only question is as to the effect of the large amount of tannin contained in them. In the above case it was 14·10 per cent. The whole difficulty of feeding this material seems very largely to depend on the existence of a variety of *babul* termed *wedi babul* by the people, which contains so much tannin that even sheep do not like it, and which is avoided by shepherds all over the country. I have an idea that a large proportion of the *babul* which was planted after the famine of 1877-78 and which forms such a large proportion of the good *babul* plantations on the Deccan was of this stamp, and it is hence of little use. The sample in my hands was apparently of this type.

7. It may be worth while to place on record the figures of the analyses of a number of samples of rice *konda*, consisting chiefly of the inner husk and germ obtained in grinding rice. This material whose value as a feeding stuff is fairly recognised among the people is really one of the richest materials which are usually available in the Bombay Presidency. The following are the figures for four analyses :—

	1	2	3	4
	Per cent.	Per cent.	Per cent.	Per cent.
Moisture	7·80	7·67	9·04	8·42
Oil	8·27	7·63	11·18	7·10
*Proteids	33·36	31·56	32·50	34·13
Soluble Carbo-hydrates	36·36	40·76	34·17	39·57
Woody fibre	4·80	4·60	5·30	4·90
Ash	9·41	7·78	7·81	5·88
	100·00	100·00	100·00	100·00
* Containing Nitrogen ...	5·34	5·05	5·20	5·46
Price in Poona Bazár	20 seers per rupee.	18 seers per rupee.	18 seers per rupee.	22 seers per rupee.

8. A large part of the routine analyses done, for the general public at any rate, consists in analyses of samples of irrigation water and of soil. In the case of the former it is astonishing how very salt many of the waters used successfully are. Waters containing up to two hundred parts per 100,000 of salts in the waters are successfully employed, provided most of the salt is Sodium Chloride or Sodium Sulphate. If, however, there is even a very small quantity of Sodium Carbonate in proportion to the quantity of other salts, then the water is liable to do great damage. Such waters occur apparently not uncommonly n the North Deccan. In my last annual report I referred to one series of wells near Málegaon in the Násik District where what was otherwise an excellent irrigation water was rendered almost useless by the presence of not more than twenty parts per 100,000 of Sodium Bicarbonate. Another similar case came before me this year from Bhamna village near Amalner in East Khándesh. In these cases the analyses of the waters ran as follows :—

	Parts per 100,000.				
	1	2	3	4	5
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Sodium Carbonate ...	1·59	4·24	2·12	1·06	...
Sodium Bicarbonate ...	45·02	44·51	42·84	44·60	39·35
Calcium Carbonate ...	3·00	2·00	2·00	2·00	2·00
Magnesium Carbonate ...	8·33	6·82	11·36	8·35	12·12
Sodium Sulphate ...	3·04	3·65	1·82	1·22	2·44
Sodium Chloride ...	17·08	17·08	17·08	17·08	22·77
Total salts	70·00	80·00	80·00	80·00	80·00

I am afraid nothing can be done except to use the waters very carefully or only on highly manured garden land. The result of using them is not an incrustation of salt but simply a change in the texture of the soil which makes it very much like cement.

9. A large number of soil analyses have been made, but there does not seem enough of special interest in them to call attention to any samples in particular.

10. I may now turn to the other section of the duties of the Agricultural Chemist to the Government of Bombay, namely the investigation of special chemical problems in connection with agriculture. This has largely consisted of a continuation of the study of those detailed in my last year's report. One of these, namely a study of the methods for dealing with the question of the development of salt and barren land in the Nira Valley irrigation area, has been so far completed that a bulletin has been issued which has largely formed the basis of future action by Government in connection with this problem.

11. The first instalment of my study of the *rab* system of rice cultivation is now in the press. As a result of my work, I have formulated the following conclusions:—

1. The *rab* process as used in the preparation of the seed-bed for rice in Western India owes its efficiency to two causes—the heating of the soil, and the ash and other manurial material left on the land. The actually increased returns in the improved seedlings obtained vary very much, but normally the weight of the seedlings obtained is from one and a half times to twice as great as without the treatment.

2. Of this increase nearly sixty per cent. is due to the effect of heating, and the balance to the ash and other materials added.

3. Taking the effect of heating alone, with which the present study deals, it may be said that during ordinary burning with cowdung *rab*, the temperature at ½ inch deep does not go beyond 110° C and at 1 inch deep not beyond 85° C. The whole heating process does not last longer than 1½ to 2 hours.

4. The result of heating the soil to 75° C was only very slight at any time.

5. At temperature higher than this, a very great increase in fertility resulted up to a maximum at about 125° C. Beyond this point (at 150° C) the effect appears to be less.

6. The greatest effect is produced when the heating is conducted immediately before the sowing of the crop. If the soil is heated six weeks before the rice is sown, the effect is a little less: while if conducted three months before sowing, comparatively little effect is obtained.

7. This action of heating affects the growth of the plants. On speed of germination it has no beneficial effect, apparently slightly retarding the process.

8. The heating of the soils in question does lead to the production of a considerably increased supply of assimilable mineral plant foods in the soil, and of soluble organic matter. Very little of the benefit of heating can be due to this cause, because very little effect was produced when growing rice plants were treated with extracts of such heated soil.

9. The heating of the soils in question also materially changes the physical condition of the soil, in that a large part of the viscous sticky "clay" substance is brought into a condition which it will not remain suspended in water. This effect is a very passing one, the mere keeping of the air-dry soil for six weeks being sufficient to materially reduce it, while it has disappeared after three months.

10. The power to precipitate soil in the way described under (9) is shared by the oilcake which is most effective as a *rab* substitute (safflower cake) and by no other among the cakes at our disposal. A material like gypsum which has a similar precipitating effect gives an increase in yield of about one-quarter the amount produced by heating the soil. Further addition of gypsum beyond the

quantity required to precipitate the viscous matter to the extent done by the heating process gives no further increase in yield.

11. The change in the physical condition of the soil by the action of heat is one of the causes, though only a secondary cause, of the beneficial effect of the *rab* process.

12. The heating process has the effect of destroying a very large proportion of the active ærobic life of the soil, but even when kept in an air-dry condition the organisms rapidly again multiply till six weeks after the heating the ærobic activity is far greater than in the unheated sample. The difference disappears on further keeping of the soil.

These are, of course, only provisional conclusions, but they represent, I venture to think, a distinct step in advance.

13. The first part of a Memoir on the Composition of the Milk of Indian Cows and Buffaloes by my predecessor Mr. Meggitt and myself has been issued during this year, and several other papers by my staff and myself are almost ready for issue. Considerable progress has been made in the study of most of the problems which we have tackled.

14. My staff has remained unchanged throughout the year, and I would specially call attention to the hard and devoted work of Messrs. V. A. Tamhane, L.Ag., and N. V. Kanitkar, B.Ag., the junior Laboratory Assistants.

HAROLD H. MANN,
Agricultural Chemist.

APPENDIX H.

REPORT OF THE AGRICULTURAL ENGINEER FOR THE YEAR ENDING 30TH JUNE 1911.

(1) In the year under review great progress has been shown in the work of this department, and in the interest taken by the people, throughout the Presidency, in those matters in which the department gives advice and assistance.

(2) Most marked is the increased interest that is being taken in the possibilities of irrigation by lift, from rivers and wells, particularly from the former.

(3) A great number of enquiries are now received from cultivators and others owning lands on the banks of rivers and nullahs, and although many of these sites are quite impracticable, a certain number of them offer hopeful chances for a profitable scheme of irrigation by means of engines and pumps.

(4) The people have not yet learned even the barest essentials of a reasonably good site, but circulars have been prepared, showing the conditions under which pumping is likely to be profitable, and these are sent to all enquirers, and will also be sent to all Collectors, for issue to the Mámlatdárs and other local officers who are likely to need them, or be able to distribute them to interested persons.

(5) This pumping work is at present, and is likely to continue to be, the most important work of my department, as it is one of the most important branches of Agricultural Engineering in this Presidency.

(6) For every good pump site available on the banks of rivers and nullahs there are perhaps twenty which are quite outside the range of practical irrigation, but there are undoubtedly a large number of really good sites scattered about the Presidency, particularly in the southern portions.

(7) With pumping installations such as are generally used for irrigation, the efficiency of the plant varies directly as the size up to certain limits, that is to say, the larger the plant, the more economical it becomes to irrigate. Unfortunately large plants are the exception.

(8) The chief reasons for this are as follows:—

In the first place, the supply of water available in the dry season is generally very limited; and secondly, intending purchasers are generally not prepared, or are unable, to put down large sums of money for the purchase of large plants, and for the necessarily heavy expenditure of cultivating large areas of irrigated land. Sugarcane is almost invariably grown under such plants, and the cultivation charges for this crop are very heavy indeed.

(9) Also in many cases one man probably owns only a small portion of the area that could be commanded, the remainder being split up among several owners.

(10) If, in such cases, the owners could combine into a syndicate to purchase and work the plant, much more progress might be made, and each of them would be able to irrigate his land at a far cheaper rate than by putting up separate small units for each piece of land.

(11) The same remarks would of course apply to power-driven cane-crushers for dealing with the cane grown on such small individual holdings.

(12) With regard to pumping from wells, this Presidency does not offer very much scope. The supply available, in a great majority of wells, is very limited, and much below the quantity for which it is profitable to instal an engine and pump.

(13) A four mhote well is about the smallest on which it pays to put a pump, and such wells are considered large in this Presidency. Those with a larger supply are few and far between.

(14) In Madras Presidency many pumps have been placed in wells, but the conditions are entirely different to those prevailing here. Not only is the water generally much nearer the surface, but the supply available is much greater.

(15) Very successful results have also been obtained in Madras by borings made in the bottom of the wells, which in many cases are found to largely increase the supply. Here again their conditions are quite different to those in Bombay, and it is doubtful whether borings made into the trap rock at the bottom of most wells in the Deccan would strike any further supply, and such borings would be extremely expensive to make. In Madras, the rock, I believe, is quite soft and full of water bearing flaws, and they are also able to pierce through it in some cases and get to sub-artesian supplies.

(16) The depth of the trap in this Presidency on the other hand is believed to be enormous. It would be instructive, however, to sink a number of such bore holes and to experiment with torpedo charges in them. Such holes might possibly run through water-bearing cracks, and pockets, in the trap and a shattering charge in the bottom of them might open up still others. I should like to purchase a boring plant for this purpose.

(17) Several enquiries have been received asking for assistance in this direction, and I think many people might be prepared to spend a few hundred rupees, if necessary, on the chance of improving a well with a defective supply, on which they may have already spent perhaps some thousands of rupees.

(18) Whether such borings would be of any use can only be determined by a number of experiments, but if they proved successful both as to striking water and their financial results, it would be of great benefit in many of the dryest districts of the Deccan, and I think in any case it is an experiment that deserves to be tried, even if it results in a loss to the Department.

(19) Another matter which is arousing a good deal of interest, and which is a very important one, is the subject of steam, or oil, motor-driven ploughs. There is no need for me to dwell on the great agricultural advantages which would follow the use of such ploughs, where very heavy ploughing is required.

The Director of Agriculture has already done so on several occasions and has recently issued a pamphlet on the subject.

(20) Unfortunately very little definite information can be obtained on this subject, which will apply to Indian conditions.

(21) In Europe and in British Colonies many such machines are at work doing excellent service, but in none of the cases I have been able to investigate do the conditions even approximate to those in India. Not only are they generally used on much lighter soils than the Indian black cotton soils, but they are seldom used for ploughing to such depths as are needed here for the eradication of hariali or the cultivation of sugarcane.

(22) There is, however, not the least doubt that machinery can be purchased, which will do the work with ease, but what the cost of working will be, experiments alone can demonstrate.

* * * * * * *

(24) It is certain that to make such a scheme a financial success, most careful organisation will be necessary to ensure keeping the plant at work for as long as possible during the year, to keep it in districts where ample work can be found in a reasonably restricted area, and to ensure the plant itself being properly worked and kept in thorough order. The initial cost of the machinery is high, and every day's idleness, whether through lack of work, or through breakdowns, would greatly increase the average cost per acre ploughed, as the interest charges alone form a very considerable item of expenditure.

(25) I have received several enquiries from interested parties, asking for quotations and advice as to such sets, but up to the present no one has decided to purchase.

(26) Several enquiries have been received regarding windmills, cane-crushing plant, flour-mills, oil seed crushers, etc., and I am glad to note that quite a number of the last two classes of machines have been recently erected by private enterprise in various parts of the Presidency.

(27) With regard to the general lines on which I endeavour to work this department, a few remarks may be interesting.

(28) When enquiries are addressed to the department they are answered immediately, and if sufficient particulars are sent, advice and estimates are given. An inspection of the site is also made, if necessary, and no charge is at present made for any such procedure.

(29) If the enquirer wishes to act on the advice given, he can either take my estimates to the makers, and make his own arrangements with them for the purchase and erection of the plant, or if he wishes it, this department will undertake the work for him.

(30) In this case he is required to pay into this office, before the work is commenced, such a sum as will cover the cost of the plant and necessary sundries, and also a charge for erection, which is fixed roughly in proportion to the amount of the estimate, and work to be done, and in no case is as much as the actual cost to Government. Full drawings are then prepared, and the machinery and sundries purchased and erected by this department, the enquirer having to provide all building materials, and labour for same.

(31) The machinery is started and handed over in good working order to the owner, and an account of all expenditure submitted to him. Any unexpended balance, from the amount paid into this office, is refunded and the transaction closed. The department is afterwards always ready to give further advice, and to undertake any repairs, if possible, but takes no responsibility for the working of the plant, which is left entirely in the owners' hands.

(32) As the work of the department increases, and when the industry no longer needs fostering, I propose to draw up a schedule of charges, so that as far as this erection work is concerned, the department shall be self-supporting, but I do not propose to ever charge any profit on the work executed.

(33) I do not think this arrangement will entail any competition with commercial firms, as this class of work, such as fixing pumping machinery, in out-of-the-way places, a

long distance from any big town, is not work for which business firms are anxious. They obtain the orders for the plant from the department, without any trouble of preparing plans, or undertaing the erection, and give me good trade terms in consequence. The cultivators thereby benefit, and the industry is encouraged without injustice to anyone.

(34) As a matter of fact when business firms are asked to undertake such works, I find they seldom take any trouble to do the work as economically as possible for the owner and as, generally, they have not carefully studied the problems of lift irrigation, their installations are frequently far from being the most suitable.

(35) I discourage all endeavours to get Government to supply and work machinery of any kind at Government risk and cost. Unless machinery can be *profitably* employed there is no object in fixing it. Demonstrations of the reliability of machines to do their work are quite unnecessary, as every man who has any real interest in them can always find a machine somewhere being already worked by other people. If he has not sufficient interest to enquire about these, he is not a suitable man to have a plant himself. If, on the other hand, the man is keen and businesslike he can work a plant profitably himself. It is impossible for this department to supervise the running of the machinery at places where responsible officers are not always in attendance.

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(37) Broadly speaking the policy adopted by my department is to advise and assist those who have some sense of self-help and of businesslike methods; and to prevent their purchasing unsuitable machinery: not to endeavour to bolster up an artificial industry by thrusting gifts on the helpless and unenterprising, who will not take advantage of them. It is of no use for a man to have machinery unless he has some intelligence, a good deal of industry, and sufficient capital to make the best possible use of it; where I think these conditions are wanting, I never recommend the purchase of plant.

(38) The work of the department during the past year may be divided roughly into two classes:—

1. Advisory.
2. Executive.

(39) (*a*) The advisory work consists in answering enquiries and giving advice and estimates for various kind of work.

(*b*) *Pumping.*—By far the larger part of these enquiries have been for pumping plants. Most of them necessitate an inspection and survey of the site and some of them lead to no practical result even where the conditions are favourable, either because the enquirer has not the requisite funds or because the enquiry was merely made out of curiosity without any intention of going any further.

The latter class of applicant generally requires most information, and gives a great deal of unnecessary trouble, and it would perhaps be a good thing to make a small initial charge (as they do in Madras) before any enquiries are answered. This would have the effect of deterring those who are not *bonâ fide* enquirers.

(*c*) About 80 enquiries on pumping matters have been answered in the current year, and a list of them, giving some particulars, is attached.* The list is arranged in districts, and it will be noticed that by far the greater number of enquiries are from the Central and Southern Divisions.

(*d*) The following enquiries regarding pumping led to the installation of plants by this department during the current year, *viz.*, at

(1) Biladi, Western Khándesh.
(2) Dhárwár Farm (Government owned).
(3) Chawad-danpur, Dhárwár District.
(4) Sulla, Bijápur District.

And machines for the following are now being fixed, or will be fixed during or after rains:—

(1) Nangaon, Poona District (Government owned).
(2) Gokak Farm (Government owned).
(3) Dhulia, Eastern Khándesh (privately owned).
(4) Godhra, Panch Mahâls (Government owned).

The plant for Godhra mentioned above consists of a windmill and pump to lift water from a well for the Collector's garden.

(*e*) The following places have almost decided to erect pumping plants next season through this department:—

(1) Neginhal, Belgaum District. Private.
(2) Turmuri (Pátil), Belgaum District. Private.
(3) Turmuri (Kulkarni), Belgaum District. Private.

* Not yet ready.

(*f*) I may say that each of these enquiries leads to a considerable amount of correspondence and they occupy a large portion of my time. Particulars of these plants will be found in the attached list of enquiries.

(*g*) I am frequently asked to give a list showing the cost of necessary pumping plant, and of working expenses, for sites with different lifts and capacities. As I pointed out in my last year's report, such a list cannot be prepared, to be of any real value. Many factors are concerned in the selection of plants, and the cost of fixing and operating the same. These factors vary with every site, and any general list of estimates would be worthless and misleading. Every site must be considered individually and a special estimate prepared for it. The cost of plant for any two sites, having the same total lift, and requiring same quantity of water, might vary by 100 per cent. or even more, depending as they may on the difficulties of fixing, arrangement of pump or pumps to deal with flood conditions, length of lead, period of pumping, etc., etc.

(*h*) I have, however, prepared a comparative statement, Statement No. **1**, for different sized pumping plants suitable for one particular set of conditions. The use of this table is that it shows the great advantage of using large plant, if possible. The different sizes of plant on each lift have been assumed for exactly similar conditions, as to method of fixing, length of pipes, etc., except that they command larger or smallar areas of land.

(*i*) For the reasons stated above the *actual figures* given must not be considered as applying to *any* given site where the lift and quantity is as stated, but the *comparison* between the cost and efficiency of the various sizes may be taken as representing, fairly accurately, the *comparative* cost of small and large plant under any set of conditions on those lifts.

(*j*) Thus it will be noticed that on a 20′ lift the capital outlay for plant capable of irrigating 75 acres, for a given time and under certain conditions, is less than double the capital outlay for a plant to irrigate only 19 acres, under similar conditions, while the cost of irrigating per acre per annum, under these conditions, with the larger plant is less than half the cost with the smaller plant. This *comparison* will hold approximately true for any given set of conditions, although the *amount* of the figures in each case may be quite different. The *actual figures* given are for a very favourable set of conditions.

(*k*) A table, statement No. 2, is also given showing the comparative cost of steam and oil engine plants *for a given set of conditions*. Any variation of these conditions will at once alter the comparison, but for the conditions given the list gives a fairly accurate comparison.

Sugarcane mills and other machinery.

(*l*) Five enquiries regarding cane-crushing mills have been received and estimates provided. Of these, that from Násik has led to practical results, and a plant will be installed after the rains.

(*m*) Four enquiries for flour mills were answered and estimates given, but none have been purchased or erected through this department.

(*n*) Several estimates were also given for oil seed mills, but with no results as far as this department is aware.

(*o*) Five enquiries for steam or oil-motor ploughing sets were received, and advice or estimates given, but no such plant has yet been purchased.

(*p*) Ten enquiries regarding blasting in wells and sinking boreholes were received, but nothing could be done as the department does not possess the necessary plant.

(40).—*Executive Work.*

(*a*) (i) *Inspection and survey tours.*—A great deal of touring has been necessary during the past year to inspect and survey proposed pump site, etc. My tours have been arranged on the most economical lines possible, and in no case have I gone over the same grounds more than once, except where further visits were necessary to inspect progress of work in hand.

(ii) Practically all the places, from which enquiries came, necessitating a visit, have been inspected, with the exception of those in the Sátára District, which I was unable to manage in the present season in spite of my being on tour continuously from October to July, with only short visits to Poona, for work which could not be done in districts.

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(xvi) Altogether in the 9 months during which touring was possible, I visited some 95 places spread over the greater part of the Presidency and generally at long distances from the railway; besides supervising the erection of 4 new pumping stations, repairs and alterations to 8 Government owned plants, preparing plans and estimates for same, and in answer to enquiries: the inspection of 12 Municipal water-works and reports to Government thereon, and a lengthy report for Government on the revision of the Bombay Boiler Act.

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(40) (*d*) The pumping work especially is as beneficial to the people as any branch of engineering, since it can touch famine-stricken districts where ordinary flow irrigation or irrigation by indigenous methods is unfeasable, and the work should be developed and encouraged in every way possible, consistent with sound finance.

(40) (*e*) *Preparation of drawings and purchase of plant.*—The second part of the department's work, in connection with new plant, for both Government and private installations, consists of preparing detailed drawings and estimates, and purchasing all necessary parts. The preparation of accurate detailed drawings is most important not only to ensure accuracy and simplicity of design, and to facilitate erection, and the prompt despatch of all necessary parts, but also for record for future reference, when repairs or alterations are required. For those plants which were erected by the department before my appointment, not a single drawing is available, except in some cases, the makers drawing of the machines themselves. There are no records whatever of the way in which they are fixed, and in consequence, whenever any alteration or repair is needed, an inspection at site is necessary, and no particulars of the foundations can be obtained. With plants situated in places far distant from headquarters, and difficult of access, complete details are essential, and full records of all work carried out since my appointment are now available for further reference.

(40) (*f*) *Repairs and supervision of existing Government plants.*—(I) The plants now owned by the Agricultural Department are as follows :—

Mánjri Farm 18 B. H. P. Oil engine and cane crusher.

Málegaon 23 B. H. P. Portable Oil engine and cane crusher.

Dhárwár Farm 6½ B. H. P. Portable Oil engine, pumps, and cotton gin.

Nadiád Farm 6 B. H. P. Oil engine and pump.

Surat Farm 6½ B. H. P. Oil engine, pump, cotton gin, and chaff cutter.

Ganeshkhind Botanical Gardens, 8 B. H. P. Oil engine and pump.

Ghotowda No. 1, 6½ B. H. P. Portable Oil engine and pump.

Ghotowda No. 2, 10 B. H. P. Oil engine and pump.

All the above were erected before my appointment (II) At Mánjri Farm the cane-crusher and engine had never been properly fixed or worked, and had been a source of constant trouble, with frequenf break downs, during my first year. As soon as crushing was completed last year, I make several alterations to the plant, refixed some parts of it, thoroughly overhauled and repaired all the damaged parts, and gave full instructions to the Superintendent, for the supervision of the engine driver, impressing on him the importance of having the engine driver properly supervised. The results have been most satisfactory and during the past season, the plant has worked without a single hitch.

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(IV) The engine and pump at Dhárwár Farm gave some trouble in 1909-10, and in the cold weather it was overhauled and repaired. It has worked very satisfactorily since then, and an additional 2 inches drum pump which was in stock, has been fixed in a second well, which the engine (being portable) drives alternately with the original pump and the gin. The supervision given to the working of this engine by the Farm Superintendent and the records of daily work, are particulary good, and it is the most economically run engine that I know of. The results obtained might well be emulated by other Farm Superintendents.

(V) At Nadiád there is a 5 B H. P. Oil engine driving a 3 inches drum pump in a deep well. The pump had been at work for several years and had been rapidly becoming less and less efficient due to wear, until towards the beginning of the past season it became practically useless. These drum pumps do not lend themselves to repair, and a new pump had therefore to be considered. I tried to obtain a high efficiency 3-inch centrifugal pump within the power of the engine to replace the drum pump, but unfortunately the engine is so small that on the high lift 65 feet of this site, no such pump could be obtained, and the only alternative was to purchase another drum pump. This could not be bought from stock in Bombay and has had to be brought from England. It has now been received and fixed.

(VI) The Surat engine has worked at regular intervals, as required, throughout the current year without giving any serious trouble. The work of the engine driver, however, is not well supervised, and the daily records are very negligently kept. Much higher economy could be secured if more attention was paid to the points mentioned in my "Instructions to the Engine Drivers," particularly as to grinding valve and thoroughly cleaning.

The Superintendent ought to see that these are properly and regularly carried out, and also that the daily records are written up accurately from the actual quantities of fuel and stores used each day.

A scrutiny of these records would then reveal at once any defect in the working of the engine, and they would besides be a check on the stores purchased and would provide useful statistics of running expenses with the different machines.

(VII) *Ganeshkhind engine and pump.*—A great deal of trouble was experienced with this plant owing to several causes, the principal being the fault of the very careless engine driver employed and the lack of supervision of his work. The engine was thoroughly overhauled and repaired last cold weather and was adjusted by my fitters. The engine driver however continualty altered these adjustments with bad results. Some alterations were made in the distribution system, the delivery pipe being lengheened by 90 feet and raised about 3 feet so as to command a larger area. The arrangements for distributing the water were not complete at the end of the year under report, so that the engine has not been used this hot weather. The system is now complete, and it is hoped to run the engine and pump every day during dry season in future, and irrigate up to the full capacity of the plant and possibly to start a class there for the training of engine drivers.

(40) (*g*) A few repairs to plants belonging to private owners have been made, but generally these plants are carefully looked after by their owners and but few repairs are needed.

(40) (*h*) (I) The erection of private plants has occupied several of the fitters of the department for some months.

(II) The first plant to be erected was that at Biludi in Western Khándesh. This was completed in November last, and the machinery has worked without a hitch since then. As at present arranged, however, the delivery of the pump only commands a few acres. About five acres only were irrigated in the past season, the engine working one day per week. The delivery is now being altered, so as to command a much larger area, by pumping through 1,800 feet of earthenware pipes to the highest point of the owner's land. When this is completed the full capacity of the pump can be utilized.

(III) The next private plant fixed was that at Chawad-danpur in the Dhárwár District. This consists of a steam engine and pump fixed on a river bank.

The engine was purchased second-hand by the owner without any expert advice, and he then bought a new pump which he considered suitable for his engine, also without advice.

(IV) Another private pumping plant has been erected at Sulla in Bijápur District. The site on which it is erected is a most excellent one, in fact the best I have yet seen, and I hope that very good results will be obtained with it. The plant consists of 6½ B. H. P. fixed oil engine and a 4-inch centrifugal pump. It started work in June and has been working well up to date (July 31st). The owner is very pleased with it and will irrigate about 20 acres of land each year with sugarcane.

(40) (*i*) The erection of Government plants has been confined to the completion of the *Ghotowda No. 2* plant, some alterations and additions to the Málegaon plant, making new fixing for engine and pump on Dhárwár Farm, and to the erection of the large suction gas engine and turbine pumps at Nángaon. The latter work is now in progress. It is not proposed to erect any further Government plants on private land, but at Gokák Farm an engine, pump and cane crusher will probably be erected after the rains. The Nándgaon plant, which was then under consideration, was fully described in my last annual report. It is hoped to have it working about December next.

(41) A short note was contributed to the Shetki Shetkari on engines used for agricultural purposes. As this is of general interest it may be included here. The points emphasized in the report are of the utmost importance and should be fully realized by all persons intending to purchase machinery.

(42) Copies of my notes on "Selection of pump sites" (Form A.) and information required when estimates are asked for (Form B.) and also information required when estimates are required for pumping from wells (Form C.) are attached. These forms should be circulated as widely as possible among all owners of prospective pump sites.

A Note by A. A. Musto, Esq., Agricultural Engineer, Bombay Presidency, on Engines used for agricultural purposes.

At the present day, with the many improved mechanical appliances used in connection with agriculture, there is a growing demand for mechanical motive power. In this Presidency the prime movers are confined almost exclusively to steam, oil and suction gas engines, electrical and hydraulic power being practically non-existent. Among the non-

technical classes of users there is considerable difference of opinion or rather lack of knowledge as to which of these engines is the best or more suited to agricultural purposes. Those who have had no experience of oil and gas engines seem to have a feeling that they are much more difficult to manage and not nearly so reliable as steam engines. There is perhaps something to be said for this view, since an oil engine can be more easily put out of adjustment by a careless driver and unless properly lubricated and cleaned will undoubtedly give trouble. A steam engine, on the other hand, has less parts which can be tinkered with, and even when somewhat out of adjustment, will still work, though very inefficiently, as long as steam is supplied to it. The oil engine, which has to generate its power within itself, will not so easily work at very low efficiency. This, however, is in one way an advantage to the oil engine. It should be the object of every user of an engine to keep it in good working order and running at the best possible efficiency. To do this with either oil or steam engines, requires only a little care and intelligence, and unless the owner is prepared to give such attention to his engine driver as to ensure that he is taking this care, and that he understands the few simple things necessary, the prospective owner will do well not to purchase an engine at all. The class of man usually employed to work an engine, for agricultural purposes, is merely a trained cooly, and such a man cannot be expected to work satisfactorily without supervision. If this necessary supervision is given, the oil engine may be relied on to give quite as satisfactory results as a steam engine.

These remarks apply more particularly to engines used for driving pumps, which is a very steady load and eminently suitable for an oil engine. For some classes of work, where very sudden loads may be applied and then withdrawn, the oil engine is not so suitable, and it is necessary to use an oil engine of larger power than would be necessary with a steam engine.

If, however, the oil engine is sufficiently powerful to overcome the sudden heavy load it will work the plant satisfactorily.

A cane crusher is an example of this kind of load, as the men feeding may suddenly cram into the machine too much cane, and for this kind of work the steam engine is perhaps preferable. At the same time there are several cane crushers doing excellent work with oil engines, *viz.*, at Mánjiri, Government Farm at Loni and at Karanja, all in the Poona District.

The case of suction gas engines is somewhat different. In the first place, they can at present only be recommended for engines which are fairly large for agricultural work, not less than, say, 25 to 30 B. H. P. These plants are more complicated than oil engines, and should always have a fairly good mechanic in charge of them, or at any rate a man with a thorough training and experience with them. For large installations where the wages of a good mechanic are not a serious obstacle, they will probably replace both oil and steam engines to a very great extent, as they are extremely cheap to run, although the first cost is high. But for small plants up to about 20 B. H. P. they are not likely to do much in the near future in this country. We see, then, that if proper care and skill is used, there is little to choose in point of reliability between steam and oil engines. The question therefore becomes a financial one. Which is the cheaper? This question depends not only on the cost of fuel, but also on the style of steam engine employed.

The cheaper and simpler kinds of steam engines and boilers are by no means economical in working, and to obtain high efficiency, which means low working expenses, a more expensive engine and boiler must be used.

The ordinary small vertical-tube boiler, driving a vertical engine, is far from being an economical plant, and for any regular work it would generally be more economical to buy the more expensive portable engine, with locomotive type boiler, which will generate far more steam from the same quantity of fuel. The prices of fuels vary in every district and fluctuate with supply and demand, so that it is not possible to state definitely, in a paper like this, and for any place and time, which is the cheaper plant.

I have however prepared comparative estimates for various kinds of plants, assuming certain rates for fuels, and an abstract of these may be instructive, and is attached herewith. It will be noticed that the capital outlay required for steam plant is greater than for oil plant, and that at the rates assumed, the annual working costs are lowest for a portable steam engine and a little more for oil engines, while for the vertical boilers and engines the working expenses are considerably more. In estimating the local rate for wood fuel it should not be forgotten that if the local supply is at all limited, the demand created may seriously increase the price. The price of oil fuel is not likely to be affected by purely local demands.

When intending to purchase any machinery, always obtain expert advice, either from Government or from private business firms, who are competent to give such advice. A little knowledge is a dangerous thing, and never attempt to estimate the plant required without getting advice which you can be sure is expert. When the advice is given abide by it, and do not attempt to alter or improve on the plant recommended. Such attempts to select plants without advice, and to alter that advised, will invariably lead to disaster, of which there are many examples in this country.

In the selection of the actual make of machine to be used, there is little to choose between at least 20 different makes, any of which can be relied on to give really good results *if properly worked.* No machine ever made is fool proof or dirt proof, but there are very few of the well-known makers who do not turn out first rate machinery. This

applies to both oil and steam engines. Each make has its own good points and in the long run, they are all very much alike in results, *provided always that they are properly worked.*

One very important point in buying plant, is to know that the agents stock a good supply of spare parts, and also have men available who can undertake repairs if necessary. Advice on this point is also valuable and necessary. Once again it must be remembered that the success of a plant is due not so much to the make machine as (1) to the care with which it is selected to suit its conditions of work, (2) the care with which it is fixed, (3) and most important of all, the care with which it is worked.

STATEMENT No. 1.

Statement showing comparative "Capital Cost" and "Working Expenses per acre of sugarcane per annum" for different sized pumping plants on various heads. Similar conditions being assumed in each case, as to period of pumping and arrangements for fixing, etc.

Size of Plant driven by an oil engine.	Lift.	20′	30′	40′	50′	60′
3″ *Pump* (equivalent to about 7 mhotes) capable of irrigating *19 acres* of sugarcane per annum when working 10 hours per day.	Capital Cost ...	Rs. 1,900	Rs. 2,100	Rs. 2,400	Rs. 2,650	Rs. 3,000
	Cost of working per acre per annum.	61	67	85	100	120
4″ *Pump* (equivalent to 12 mhotes) capable of irrigating *33 acres* of sugarcane when working 10 hours per day.	Capital Cost ...	2,200	2,500	2,700	3,100	3,400
	Cost of working per acre per annum.	39	46	56	69	76
6″ *Pump* (equivalent to 28 mhotes) capable of irrigating *75 acres* of sugarcane when working 10 hours per day.	Capital Cost ...	3,500	4,000	4,200	4,900	5,360
	Cost of Working per acre per annum.	30	37	46	55	63

The Capital Cost included carriage to site up country, foundations, fixing, necessary piping and engine house, in fact complete plant in working order.

Working Expenses—include allowance for interest on outlay at 6 per cent. depreciation repairs, fuel oil, lubricating oil, sundries, and drivers, wages, all assumed for a working season of 240 days and 10 hours per day.

STATEMENT No. 2.

Comparative Statement of Capital Cost and Working Costs of various types of Engines under certain assumed and similar conditions.

	Vertical Engines and Boilers suitable for wood fuel.				Portable steam engine for burning wood.	Stationary oil engine kerosine fuel.
	Vertical cross-tube boiler.	With cross-tube boiler and feed water heater.	With Hopwood boiler.	Hopwood boiler with feed water waste.		
6½ B. H. P. Engines.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Cost of engine (and boiler), plus 33 per cent. for carriage to up country station, foundations-housing and erection.	1,824	1,900	2,063	2,139	2,000	1,295
Working Expenses for 2,000 hours per annum, including allowances for interest on outlay, depreciation and repairs.	1,491	1,342	1,377	1,259	1,018	1,284
	Note.—A of wood annual e	difference i fuel will m xpenses:—	n price of 8 ake the fo	annas per llowing diff	1,000 lbs. erences in	A difference of 4 annas per 8 gallons of kerosine will make the following difference to annual expenses.
	110	94	95	82	60	47
26 B.-P. Engines.						
Cost of engine (and boiler) as above	3,591	3,667	3,780	3,856	3,900	3,493
Working expenses as above.	5,513	4,809	4,761	4,182	3,220	3,573
	Note.—Di following	fferences in differences	prices of f in annual	uels as abo expenses.	ve makes	
	470	400	390	330	235	135

Note.—The following rates for fuel have been assumed for the above calculations, *viz.*, Rs. 5 per 1,000 lbs. of Bábul wood fuel and Rs. 5 per 8 gallons (2 tins) of kerosine fuel. (Kerosine is at present less than Rs. 5) also a greater allowance has been made for depreciation of oil engines, than for steam engines, and sufficient is set aside under this head, to provide complete new machinery when necessary.

FORM A.

Points to be considered in selecting Pump Sites on a River Bank.

(1) It may generally be considered that pumping will not be profitable if the total height, from the lowest level of the river in dryest season up to the highest point of the land to be irrigated, is more than 50′. The less this height, the cheaper pumping will be, and in selecting a site, one should always be looked for *where this total lift is as low as possible.*

(2) If possible find a site *where the land is nearly level, right up to a steep bank.* In this case the water can be pumped up and delivered close to the edge of the bank, and from here it will flow by gravity over the whole land to be irrigated. When the land *slopes up* for a long distance away from the bank, it is necessary either to pump the water through a long and expensive pipe to the highest point, or to make a high bank with a water channel on the top to carry the water from the pump to the highest point; in both cases an expensive arrangement.

(3) The land should of course be good cultivable soil and as nearly level as possible. Uneven ground is not suitable for irrigation and must be levelled as well as is practicable.

(4) A good site for the pump should be found on the bank, as close as possible to the dry season water level, but at the same time *just above the highest water level at which pumping will be required.* It does not matter if the pump is immersed by high floods when it is not required to work.

(5) Having found the pump site, a suitable place for the engine must be found. This should be on the high bank above all flood levels; but at the same time within 20′ or 25′ of the pump site.

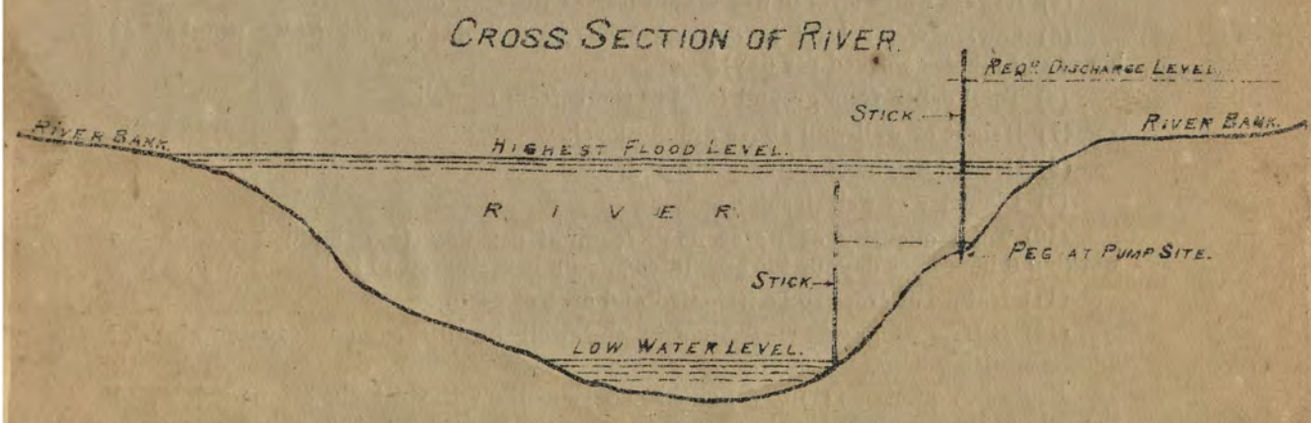
FORM B.

Particulars required of Pump Site.

First drive a stout wooden peg into the river bank at the place where you think the pump might be placed, *measure all the heights* and *distances asked for from this peg.* Keep the peg in the ground for inspection, in case an officer is sent to examine your site.

Note.—Questions 1 to 5 are *vertical heights,* that is, measured straight down, as a stone would fall in the air.

When places are *below* the peg, the levels can be measured roughly by standing upright *at the place* a long stick, and stretching a line from the stick to the peg, as nearly level as you can guess; then measure the stick up to this line. Or if the place is *above* the peg, stand the stick *on the peg* and stretch the line, as level as possible, from the stick to the place; then measure the stick up to the line. See sketch below.



Questions 6 to 8 are *distances* measured with a tape *along the ground.*

Wanted:—

(1) The *vertical* height from the peg to the lowest water level known in the last 20 years.

(2) The *vertical* height from the peg to the present water level.

(3) The *vertical* height from the peg to the highest flood level known in the last 20 years (say whether it is above or below the peg).

(4) The *vertical* height from the peg to the highest water level at which it would still be necessary to pump.

That is to say, you might have a flood running down the river but no rain at your place. It would then be necessary to pump and irrigate your land. I want to know this highest water level, you have ever known, during a long break in the rains, when you would need to pump.

(5) The *vertical* height from the peg to the place where you wish to lift the water, in order to irrigate your land; that is, to the delivery point of the pump pipe.

(6) The *distance*, measured along the bank, from the peg to the present water level.

(7) The *distance*, measured along the bank, from the peg to the point on the bank where the highest flood level reaches.

(8) The *distance*, measured along the bank, from the peg to the place where the water is to be delivered by the pump.

(9) The quantity of water now required (say number of mhotes required working 8 hours per day, or number of acres of each crop to be irrigated *each year*).

(10) The estimated greatest supply available in the dryest season (say number of mhotes working hours per day).

FORM C.

Particulars required when advice is asked as to pumping from wells.

Note.—All levels should be measured *from ground level.* If the well wall is built up above ground a mark should be made inside the well at ground level and all levels measured from this mark.

(1) Highest water level during rains.

(2) Water level during a break in the rains when pump is still required (before working mhotes).

That is to say, during a break in the rains, you might have high water in your well but no rain. It would then be necessary to pump and irrigate your land. I want to know this highest water level you have ever known during a break in the rains, when you would need to pump).

(3) Water level after a full day's work in rainy season. (State number of hours and mhotes worked per day).

(4) Lowest water level in dry season (*before* working mhotes).

(5) Lowest water level in dry season *after* full day's work (state number of hours and mhotes worked per day).

(6) Total depth from ground level to the bottom of well.

(7) Height of well-wall above ground level.

(8) Desired height of delivery above ground level.

(9) Diameter of well (inside).

(10) Total quantity of water now required per day (say number of mhotes working 8 hours per day, or the area of each crop it is desired to irrigate *each year*).

(11) Nature of crops to be irrigated and area of each.

(12) Estimated greatest capacity of the well in dry season (say number of mhotes working hours per day).

Replies to questions (1) to (9) should be shown on the attached blue-print and the latter then returned to me together with replies to the other questions (10) to (12).

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